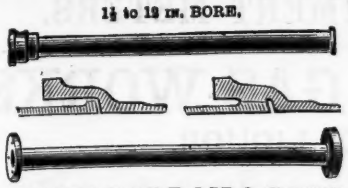
THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXI. No. 1566.] LONDON, MAY 16, 1893. [45TH YEAR. PRICE 6d.

GAS AND WATER PIPES

1¼ to 12 IN. BORE.



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Brilliant Light.

Perfectly Steady and

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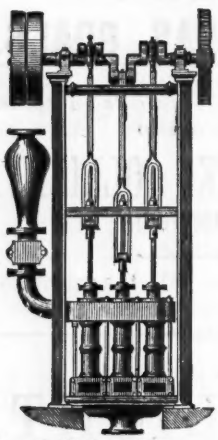

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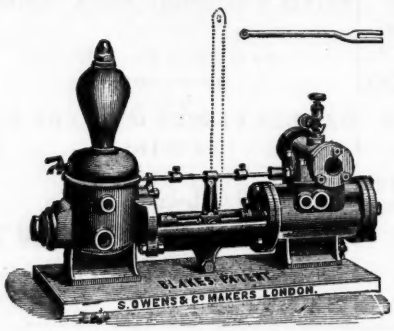

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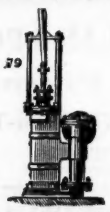

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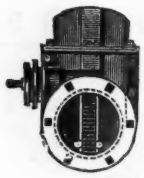

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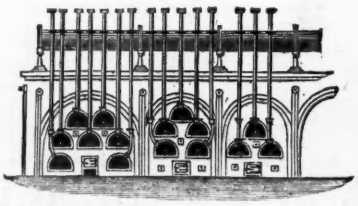

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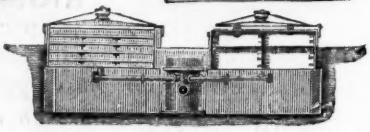

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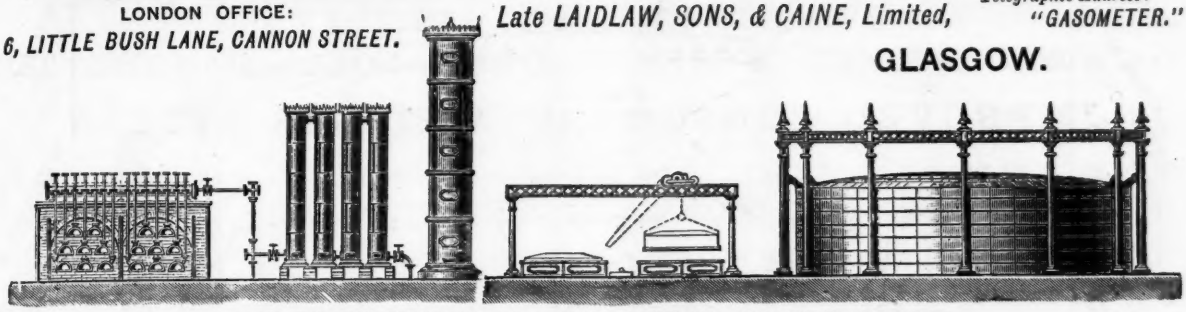

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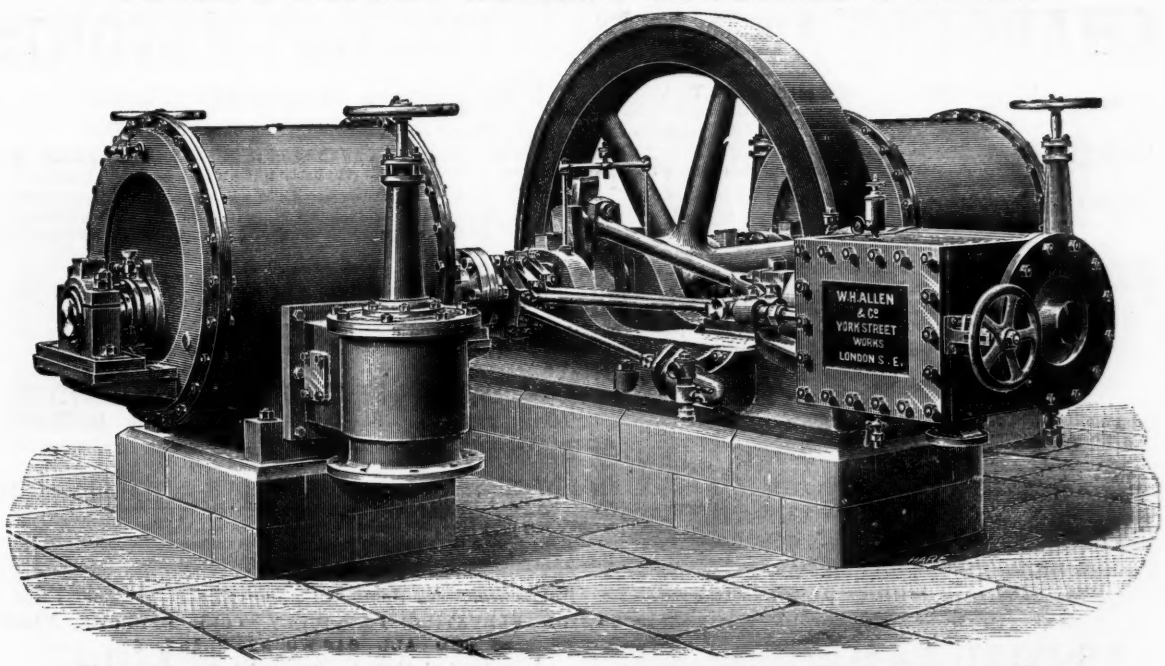

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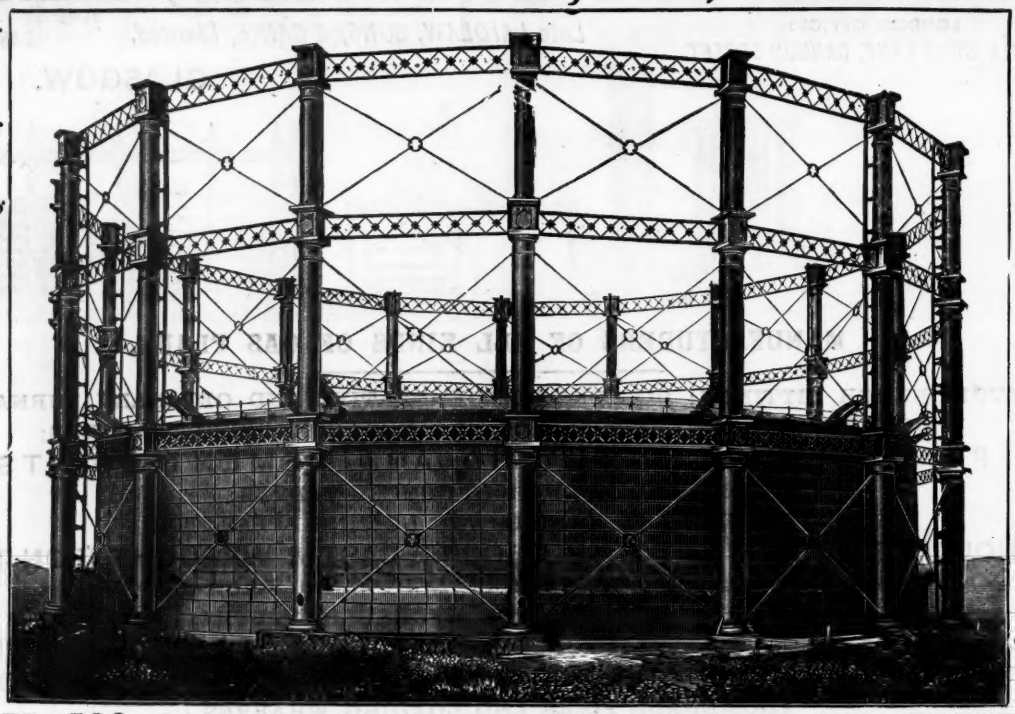

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secure a very tight joint; and at the same time the eccentric motion given to the Lid effectually removes the Tar from the surfaces of the Joint.

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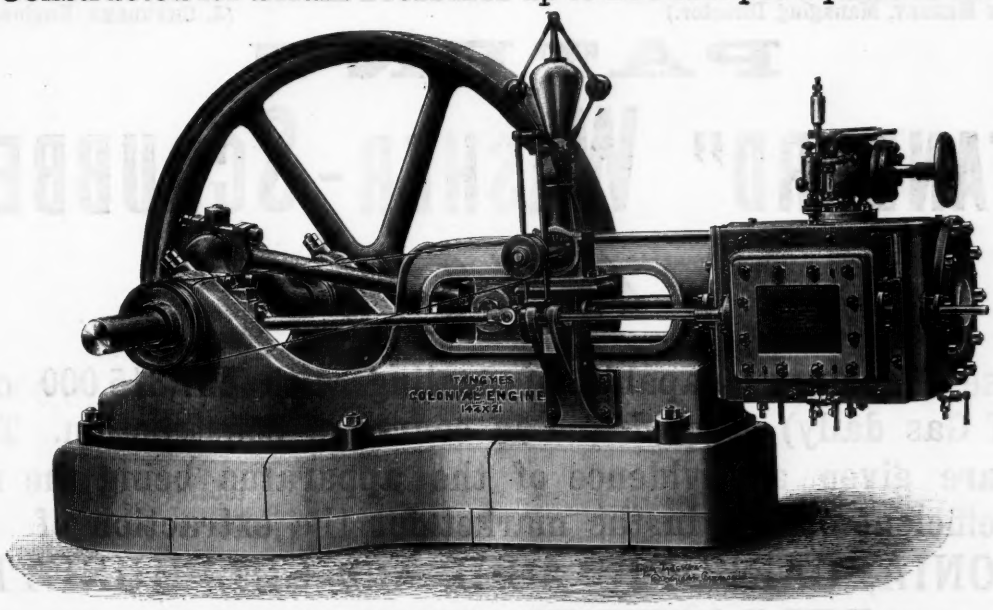
Constructed for Steam Pressures up to 100 lbs. per square inch.



Tangyes' "Colonial" Steam-Engine, with the TANGYE-JOHNSON PATENT AUTOMATIC CUT-OFF GEAR. From a Photograph of the 14½ in. by 21 in. size.

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PATENT

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459

of these Machines (capable of dealing with 437,315,000 cubic feet of Gas daily) erected and in course of construction. These facts are given as evidence of the apparatus being the most efficient of any in the market for the extraction of

AMMONIA, CARBONIC ACID, AND SULPHURETTED HYDROGEN FROM COAL GAS.

A large number of the above Machines have been constructed according to the Company's latest Patent, which has also been applied to original pattern Machines at many Works.

TESTIMONIALS.

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Gentlemen,

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I am, yours truly,

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Extract from the JOURNAL OF GAS LIGHTING, &c., for Sept. 27, 1892, referring to the visit of the Members of the Eastern Counties Gas Managers' Association to the Lowestoft Gas-Works—

"Mr. J. Ayris has one of Messrs. Kirkham, Hulett, and Chandler's "Standard" Washer-Scrubbers in operation (capable of dealing with 500,000 cubic feet of gas per 24 hours); and of the working of this machine he spoke very highly."

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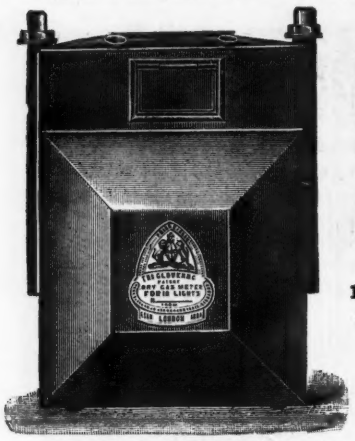

1st.—Are a remedy for all the defects of Wet Meters.
2nd.—Are suitable for all Climates, whether hot or cold.
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4th.—Cannot become fixed by Frost, however severe.
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9th.—Will last much longer than Wet Meters.
10th.—Will not cost more than one-half for repair that Wet or Water Meters do.
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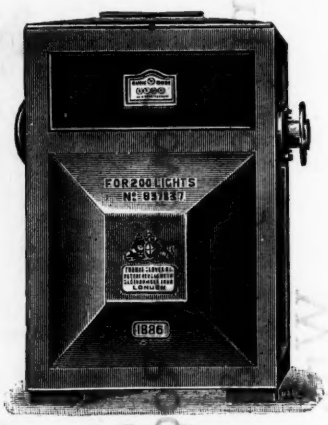

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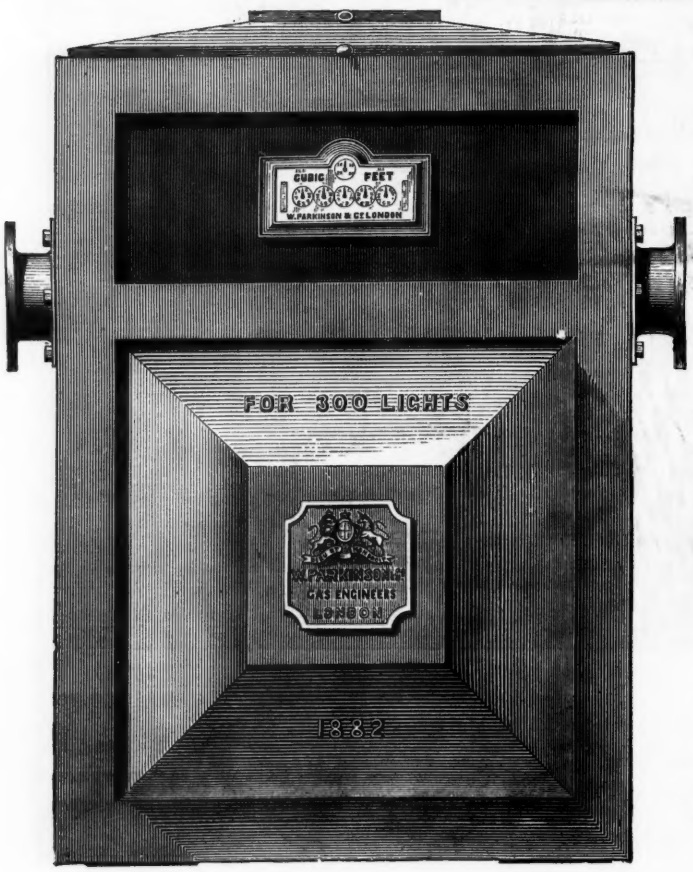

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THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, MAY 16, 1893.

The Meeting of the Incorporated Institution of Gas Engineers.

THE meeting of the Institution of Gas Engineers last week, under the presidency of Mr. John Methven, must be described as successful in regard to the character of the proceedings, but not so satisfactory with respect to the attendance, which was thin throughout. It was a very busy week for London in many other ways; and the circumstance that the first day of the meeting was also the date of the inauguration of the Imperial Institute was unfortunate for the more modest gathering. The small but devoted band that supported Mr. Methven throughout the two days of the indoors meeting, had their reward; for the papers read constitute a respectable addition to the literature of gas manufacture, and the discussions were in the main ample and pointed. Every paper, indeed, was adequately discussed except the last, which was pinched for time. Mr. Methven made an excellent President in every sense. His Inaugural Address did not come fully up to expectation; but the conditions of his case were not altogether propitious for the production of a masterpiece in this line, and nobody will wish to be hard upon the Engineer on whose shoulders falls the burden of Beckton. His management of the debates was excellent; but he did himself most credit on Friday, when he was exhibiting the work he has in hand at the huge gas manufacturing station in the Barking Marshes. Never was Beckton more thoroughly and comfortably seen; and never did it look better, from the practical gas maker's point of view.

None of the papers possessed transcendent merit; and the majority were more didactic than suggestive. Papers which are records of experience or reasoned statements of opinion, like those of Mr. Belton and Mr. Livesey, are extremely useful, both in eliciting discussion and furnishing matter for reference. They are not, however, the highest class of papers, which distinction must be reserved for those of the suggestive order. The paper that tells us what we want to know is good, and the author deserves our thanks; but the paper that sets us thinking for ourselves is likely to be most fruitful, and to do us most service in the end. The recent meeting was not destitute of contributions of this kind, as, for instance, the paper of Dr. Hood and Mr. Salamon, which was almost a lecture, and the productions of Professor Vivian B. Lewes and Mr. Glasgow. Moreover, all these papers related to subjects of high interest to British gas manufacturers, and are calculated to set the latter thinking to good purpose. How best to make and purify his gas are topics of cogitation perennially interesting to the gas maker, who is naturally loth to admit that he knows all that can be known in regard to the data by which such problems must be worked out. The things that he does know are apt to be new to outsiders who look at gas making from the purely scientific standpoint, while the views of the latter are likely to present old facts in a new light.

Thanks to Professor Lewes and Mr. Glasgow, and Dr. Hood and Mr. Salamon, the British gas manufacturer now knows a few more data relating to gas making and purifying than were generally known before last week. He has heard what illuminating gas by the cupola process actually costs in this country; and the path of feasible improvement in this way of gas making has been pointed out. He has also had his attention directed to a possible way out of the "No Thoroughfare" in which the sulphur purification of coal gas has been blocked for years. As to water gas, we are now assured, on unimpeachable authority, that the views long held and repeatedly expressed in the JOURNAL are correct. Bulk for bulk, and quality for quality, carburetted water gas cannot yet compete in this country with coal gas in regard to cost price in the holder. It is, in point of fact, from 25 to 30 per cent. dearer than coal gas, even when made on the Beckton scale and in Beckton style. Is there anywhere else a Lowe plant capable of turning out six million cubic feet of gas per day? Although water gas is dearer than coal gas, however, at current English rates for suitable oil, which is the *crux* of the process, the existence of such plant at Beckton, on such a scale, testifies to the fact that the gas must have its advantages. What these are need not be set forth again here. As to sulphur purification, it is safe to state that the theory of the matter has been advanced a step, however wide may be the gap between what should be and what can be done. Surely, a technical meeting cannot be esteemed other than a success that has been instrumental in advancing the science of gas manufacture by these stages.

The Institution was highly favoured by the Directors of The Gaslight and Coke Company, who have manifested in their relations with the organization a geniality of spirit, and a degree of consideration for their officers connected with it, which deserve acknowledgment. Is it too much to express the hope that the Institution may in time be able to make some return for this kindness, by helping to dissolve the barrier of reserve and seclusion that has

separated—to the injury of both parties—so many of the staff of the Company from their professional equals outside? It does everybody good to rub shoulders occasionally with his fellows; and whatever may be the motive that still keeps many gas managers to themselves in London or the country, it is a mistaken one.

The Gas Supply of Birmingham.

THE annual reports of the Birmingham Corporation Gas Committee are usually interesting reading, from the observations they generally contain upon leading features of the gas engineering science of the day, which are certain to be mirrored in the practice of the two head-quarter stations of Windsor Street and Saltley. The report for the working year ending March 31 last, which will be found in another column, is no exception to the rule. It begins with a reference to the completion of the settings of inclined retorts at Windsor Street, and explains that, before determining upon any extension of the system, it has been decided to obtain means of comparing its working with that of horizontal retorts fitted with the most modern form of charging machinery. With this view, some Foulis-Arrol hydraulic plant is to be laid down at an expenditure of £3357, which will be money well spent, since the result of this comparative carbonizing test will be definitive. It is good policy, also, to introduce as much machinery as can be properly employed in coal and coke handling, as the Committee contemplate doing. All these things are proofs of the Committee being ruled by a progressive spirit, in the best sense of this much-abused term. The report contains some instructive statements respecting workmen's holidays and coal contracts. Corporation gas undertakings have not hitherto been so liberal in the former matter as the best administered English gas companies; and therefore the Birmingham Committee are to be heartily congratulated upon their present action. It is, however, doubtful whether the Committee are to be equally felicitated upon their decision to suspend for the year the usual payments to the sinking fund, in order that the subsidy to the municipal treasury may be made up. This is a very cheap and easy sort of financing; but the public never thinks very highly of the Chancellor of the Exchequer who, to avoid a deficit, suspends the service for the redemption of the National Debt. No special notice is taken in the report of the real reason why this decision has been arrived at—the falling off in both gas-rental and in residuals, the latter to a very considerable amount compared with the previous year. The accounts supply several other facts respecting which a little further enlightenment than is offered by the report would be desirable. Marked efforts appear to have been made at the works to square the revenue account, in view of the deficiency of income. Coals were cheaper; but purifying expenses increased nearly double—thanks probably to the introduction of sulphur purification. The salaries were cut down, though wages went up; and repairs and maintenance dropped from £76,471 to £44,514. Rates and taxes also show a considerable increase. Altogether, in view of the changeful activity represented by these contrasting figures, it is creditable to the administration that the normal balance is so well maintained. It can easily be believed that a year of cheap coal will be welcomed by the Department.

Failing Trade.

THERE are many indications that the country is entering upon a period of trade depression, which may endure a long or a short period, but is certain to affect many industries disastrously while it lasts. Coal prices have been tumbling down portentously, and contracts have been striven for at what retail dealers call "alarming "sacrifices." No longer does the coalowner laugh in the face of the gas manager; and the haughtiest agent is humbled. The strength of the market is once more with the buyer; and the see-saw of trade has furnished another illustration for the diatribes of the Socialist, and another puzzle for the student of Political Economy who seeks for the reasons as well as watches the mechanism of industrial fluctuations. Why should these things be? Why should coal, for instance, which lies where it is until dug up, be a drug in the market at one time, and be unobtainable for any money at another? Professors of Political Economy talk of many things at great length; but not one of them is any nearer to a knowledge of the courses of trade than are the meteorologists to understanding clearly why one summer is wet and another dry. One thing at least is tolerably sure: If the present abnormal drought should last much longer, the corn crops will suffer; and Europe will be sadly the poorer. Depression will then be severe and protracted; many a tradesman and manufacturer will fail, many an investor will lose his all, many a poor family will go hungry next winter. It is some satisfaction to remember that, amid all this suffering from bad trade, gas will be cheaper again. And it will need to be. We mention these considerations here in order that gas directors and committeemen, and all who are concerned in the matter, may be helped to realize the benefit that cheap gas is to a community labouring in the trough of trade depression. It is at such times that the importance of the odd penny per 1000 cubic feet in the price of this necessary of town life is felt; and we hope that, as soon as they can see their advantage secure in respect of cheaper coal, those who are responsible for the administration of gas undertakings throughout the United Kingdom will hasten to announce what difference they are able to make in the price of gas. The Roman proverb says that he who gives quickly gives twice; and it would be a comfort to many a struggling trader just now if he could look forward to lighter gas bills for the coming winter.

The Hull Strike Drawing to its End.

FROM statements contained in yesterday's newspapers, we gather that the leaders of the Hull strikers are anxiously and laboriously attempting to construct, with materials supplied by Mr. C. H. Wilson and the Shipping Federation, a "golden bridge" for their own retreat from a lost position. They must see plainly enough that the game is up; but as they have been sufficiently clever during the course of the strike to misrepresent the issue between the Dockers' Union and the employers, so they are desperately solicitous to make it appear that the inevitable settlement has only been rendered possible at last through the employers having given way in some important particular. The facts, however, do not support this interpretation. All that the Local Committee of the Shipping Federation have done is to accept the Mayor of Hull as an intermediary for the purpose of placing their terms before the strikers; but the terms remain precisely the same as they have been throughout the struggle. These are, that members of a Union are to agree to work with non-society men—the employers making no distinction between the two classes of labourers; that no objection is to be raised to the foremen and shipping clerks severing themselves from the Dockers' Union; that the British Labour Exchange in Hull is to be kept open—"the employers insisting on "entire freedom of contract in employing such men as "they may deem suitable." In all probability, most of the men will resume work upon these terms in the course of the week, if only because it is tolerably clear that no more strike money will be forthcoming. It may be expected that the Union leaders will make out in some way that the men have gained something by the strike, or at any rate that the surrender has not been unconditional. This will be necessary if the Dockers' Union is not to go to pieces straightway, dragging the Seamen and Firemen's Union down with it, and seriously shaking the Coal Porters', Gas Workers', and all the other purely fighting Unions. One of the "popular" newspapers has obligingly proffered aid in the manufacture of an excuse by asking "What has become of the Federation ticket?" But, as has been explained several times in the course of the dispute, the so-called Federation ticket is a myth so far as shore labourers are concerned; and the strike did not begin with this cry. Several of the newspapers have remarked that, the Hull strike being essentially a struggle between organized labour and organized capital, the precise cause of the outbreak of hostilities is now immaterial. With this opinion, we distinctly and strongly disagree; holding that the lesson of Hull will be altogether meaningless and fruitless wherever its origin is not borne in mind. It was an attempt on the part of the Union to usurp the work of the port, to the exclusion of free labour; and in the subsequent course of the dispute the town has had to be strongly garrisoned in order to prevent the Union men from using violence to gain ends that persuasion failed to secure. Moreover, the Union leaders have done everything in their power to coerce the employers from having recourse to that same means of increasing their strength—mutual association and co-operation—which they were the first to

use for a similar purpose. Never must these aspects and incidents of the Hull strike be lost sight of by those who desire the industry and commerce of the country to flourish, and the lot of the unskilled labourer to be improved by lawful and natural means. The Hull strike means, if it means anything at all, that the principles and methods of the New Unionism have had their final trial, and been found wanting in the place and amid the circumstances most favourable to their operation. It will need more than casual newspaper vapouring about the imaginary disappearance of the Federation ticket to "whitewash" the reputations of the demagogues who set the time and place of the trial, and have been ignominiously worsted. There is only one thing more for the shipowners and the wharfingers of Hull to do, and it is certain that they will do it. In mercy to the suffering families of the local dockers, they must do their best to avoid the permanent swamping of the port by the imported labourers. They have already declared that they will not abandon such of the latter as may elect to remain in Hull after the industrial war is over; but that is a different thing from encouraging them to settle in a place where it is only too sure that employment for natives will be scarce for some time. There is small doubt, however, that the Hull shipowners will come out of this last test better than the miserable demagogues who, having abetted the strikers, must leave the latter to their fate as soon as they can manufacture an excuse for "officially" declaring the strike to be at an end.

Mr. R. F. Grantham on Sewage Filtration in Relation to River Pollution.—At a recent meeting of the Surveyors' Institution, Mr. R. F. Grantham read a paper on "Recent Experience in Sewage Filtration, considered in Relation to River Pollution." It is nearly eight years since the subject was discussed there. While much has since been done, there is a large area of country in which pollution is still permitted; and many villages and towns are suffering in consequence. In the necessarily brief notice of the paper we are now able to give, we can only refer to the author's conclusions. He considers that the condition of many of the rivers in the country makes it imperative that powers similar to those conferred under the Mersey and Irwell Joint Committee Act of last session for the prevention of pollution should be granted to local authorities in general; also that County Councils, or their committees, should conduct investigations for the purpose of establishing standards of purity for the rivers and streams within their respective boundaries; and that the same authorities should establish a system of examination of all the effluent waters from sewers. Mr. Grantham remarked that the State Boards of Health in America, and the Massachusetts Board in particular, seem to have authority in advance of our Local Government Board, in being able to conduct experiments on so important a subject as the filtration of water and sewage; and he expressed the opinion that it would be a great step if County Councils were enabled, through their Medical Officers, to make similar investigations.

Recognition of the Temperature at which Petroleum begins to Evolve Gases and Vapours which may Explode on Admixture with Air.—Writing in *Oel und Felt Industrie*, Herr A. Gawalowski describes a method for the above; and his remarks have been translated in the *Chemical News*. On a sand-bath heated from below by a small flame is placed a capsule containing the substance in question. Over it is turned a cylinder of glass 8 to 10 centimetres in length, contracted at its upper end, and provided below with three notches. Through each of two of these notches passes a glass tube bent upwards below the cylinder, one of which is drawn out to a point and connected with the gas-pipe. In experiments, a very small flame is allowed to burn at the point of the tube, whilst the other glass tube above mentioned introduces a direct supply of atmospheric air. As soon as the temperature is reached at which combustible gases are evolved, there ensue small detonations. The temperature is read off on a thermometer which dips into the liquid. For determining the flashing-point, the author fixes on the cylinder, which in this case is open above, a small top-piece, and over it a cap of wire netting. The tube conveying air is removed, and above the wire netting there is held a small gas-flame until the gases ignite. If no gas is at hand, a small wax taper may be used. In another arrangement, devised by the same author, which acts more accurately and also automatically, the oil is heated in a closed kettle, on the cover of which is fixed a Finkener burner. The petroleum vapours ascend in the mixing-tube of this burner, and mingle with the air admitted through a lateral opening. Near the upper aperture is a small flame which effects the ignition of the gaseous mixture as soon as a sufficiency of petroleum vapour is present. To the upper aperture of the burner-tube there is soldered a small hook, by means of which a valve is kept freely suspended by means of a cotton thread saturated with ammonium nitrate. At the moment when the mixture of gas and air is ignited, the thread burns, and the valve closes automatically, preventing the further escape of petroleum vapours from the small kettle.

THE INCORPORATED INSTITUTION OF GAS ENGINEERS.

PROCEEDINGS AT THE GENERAL MEETING,

HELD AT THE

INSTITUTION OF CIVIL ENGINEERS, MAY 10 & 11, 1893.

Mr. JOHN METHVEN, Assoc.M.Inst.C.E., President.

REVIEW OF PROCEEDINGS.

THE Institution of Gas Engineers met on Wednesday last under conditions, climatic and otherwise, which could not have been foreseen, and their effect still less predicted, by the most provident Council. It was the day of the inauguration of the Imperial Institute; and the weather was so magnificent out of doors, that to ask men, whether residents in or visitors to London, to immure themselves in the lecture theatre of the Institution of Civil Engineers in despite of such counter-attractions, was a severe strain upon dutifulness which average human nature could hardly be expected to bear. As a matter of fact, in many instances Kensington was too much last week for Great George Street; so that the attendance throughout the two days assigned by the Council to indoor business was distinctly ragged, and noticeably below last year's average. This was not the fault of the Institution, nor of the Council, nor of the readers of papers, nor indeed of anybody. It was simply traceable to coincidence, and therefore is hardly likely to be repeated.

It was to a faithful few, therefore, that the retiring President—Mr. Charles Hunt—addressed himself when, in the cheeriest manner, he performed the necessary ceremony of the "happy despatch," and opened the meeting in form, only to vacate the chair in favour of Mr. John Methven. He was not permitted to depart, however, without receiving due acknowledgment of the way in which he had discharged the duties of the presidential office. We have already put upon record our appreciation of the services rendered by Mr. Hunt to the Institution; and it would be a work of supererogation to add anything more to this testimony. "The King is dead—long live the King," is the sentiment that best fits these occasions. Mr. Hunt was good; but so is Mr. Methven, and there are more behind.

In another column will be found the text of the Inaugural Address delivered by Mr. Methven on Wednesday morning; and consequently a day too late to appear, as is usual and seemly, in the previous issue of the JOURNAL to that which contains the commentary and appreciation which it is our duty and privilege to offer on these *obiter dicta* from the chair. For this reason, among others, our criticism this time will be brief; and the address must be, in a great measure, left to speak for itself. It is somewhat short, and, while containing some good passages, and not a little information and suggestive matter, may be described generally, and not unkindly, as leaving a good deal to be desired. Mr. Methven evidently had no ambition to magnify his office; but diffidence is not the supreme virtue of a President of a scientific or a technical society. So long as he does not overdo it, men like to hear a full statement of the personal views and experiences of the President they elect to rule over their gatherings; and it is not too much to say that the members of the Institution of Gas Engineers would have preferred to hear more of Mr. Methven than he permitted to escape him on Wednesday. Let us hasten to add that the shortcoming is not irremediable, but that if, as we quite hope and expect, an autumn meeting of the Institution is arranged for, Mr. Methven will be able to take the opportunity of supplementing his Inaugural Address with some further pronouncement.

Short as it is, the address gives plenty of evidence of the existence among our leading British gas engineers of much independence of opinion upon crucial points of policy. Mr. Methven has clearly thrown in his lot with the school of purists in the matter of sulphur in gas; and he made some strong remarks upon this head—displaying, in this regard, a striking lack of that reserve which he subsequently, in opening the discussion upon Mr. George

Livesey's paper, claimed as a privilege of gas engineers who are not also administrators. He even went out of his way to say hard things of the principles embodied in the Crystal Palace District Company's Bill, which is not yet out of danger; and this, seeing that he has not been consulted in the matter, might be characterized as somewhat of a mistake in point of taste. That Mr. Livesey should have taken no notice of the passage, in moving his vote of thanks to the President for his address, is a circumstance that may be interpreted in a variety of senses, according to individual estimates of the two personages most prominently concerned in the incident. It is rather to be regretted that the delay in the issue of any report from the Standards of Light Committee of the Board of Trade should have necessarily removed from Mr. Methven's purview a whole range of subjects with which he is particularly qualified to deal. The address says something about the photometry of gas; and anything that Mr. Methven may utter on this topic is deserving of respectful attention. But it is impossible to read this portion of the address without feeling that the President has been sadly hampered by the circumstance named and his own official position, and has kept himself rigidly out of the way of temptation to fall into an undesirably false position

There is one matter connected with the Institute that was left by the Council to be expounded by the President, and was not handled by him so comprehensively as could have been wished. This was the suggestion in regard to students. When the word "students" was read in the programme of the meeting, most of the friends of the Institution must have wondered, with us, what was the idea sought to be conveyed in this connection. Inquiry has resulted in the following explanation, to which we are asked to give publicity: It is in contemplation to form, in the simplest possible way, a class of so-called "Students," under the auspices of the Institution. No application or election of candidates is required. Any member of the Institution will, however, be entitled to forward to the Secretary the name of one or more pupils of his own, or other young man in the junior ranks of the profession in whom he may be interested; and this nomination will be sufficient for the enrolling of the name in the list of students, who will have the advantage of admission to the works of any member which they may desire to visit for the purpose of inspection. The members agree to extend to visitors of this class a cordial welcome, and every facility for educational inspection of their works that can reasonably be required. The idea is a good one; and the advantage of being put in possession of this privilege is something that students of gas manufacture may be expected to value highly.

After the delivery of the presidential address, the business of reading papers was commenced with Mr. Livesey's disquisition upon "Differential Prices for Gas," which gave rise to a long and conversational discussion. It may be said that paper and discussion together constituted the most voluminous treatment of the subject that it has yet received. Nevertheless, it was not exhausted, albeit every kind and amount of difference in the pricing of gas to the various classes of consumers seemed to come up for mention. There was a lack of system in stating the questions to be debated. Mr. Livesey took differential prices into a general survey; but it is obvious that these differences need to be classified with reference to their origin, which may be geographical, administrative, or prudential. The criticism that applies to variations of price arising from any one of these considerations may be very wide of the others; and therefore any discussion upon the general idea of a difference of pricing must be desultory and inconclusive. A little more logic is certainly needed here. Mr. Livesey has taken exception to our recently calling him a "fighter;" and we willingly withdraw the "soft impeachment"—so far as this paper is concerned. But what will he say if we venture to hint that the paper is in some respects illogical? At any rate, he admits that it is impossible to draw hard-and-fast lines in this matter of differential prices for gas—which is practically the same thing. It was a pleasing feature of the first morning's work of the Institution that what Americans call "the courtesy of the floor" was extended, by acclamation, to Mr. Newbigging and Mr. Hepworth, whose presence at the meeting, together with that of some other well-known gas managers not identified by name with the membership of the Institution, showed that the sense of professional brotherhood among men of the same calling has not been extinguished in the land.

Wednesday afternoon was devoted to water gas. The heavy work of starting the debate fell upon Professor Vivian B. Lewes and Mr. A. G. Glasgow; and in the course of their two papers and the combined discussion upon them, a good deal of much-needed information came to light. Mr. Goulden's statement was, to all intents and purposes, the authoritative answer of Beckton to the challenges that have recently appeared in these columns to draw from British water-gas manipulators some facts relative to their achieved results. The information is not complete; but it is good so far as it goes. It is singular, however, that the bulk of what was said on this occasion had a drift and bearing altogether different from what was said upon the same subject a year and more ago. For some time it seemed as though the whole question of carburetted water-gas making in England was to be restricted to the point of enrichment of common coal gas. All mention of what was formerly put forward as perhaps the chief recommendations of a water-gas plant—its ready availability in emergency, whether caused by fogs, strikes, or the scarcity of cannel—was ignored, until Mr. Browne put the matter upon a fresh basis. Of course, if enrichment only is needed, pure oil gas—or cannel, now that the market has eased—will serve the turn; but was it not once urged by more than one eminent British gas engineer, that, even if carburetted water gas did cost a little more in the holder than coal gas, the plant was worth having as a stand-by? What has become of this argument?

Thursday's papers call for little comment. They were all good, and aroused very instructive debate. Mr. W. Belton, of Shrewsbury, did remarkable service to the industry by his able statement of the case for the use of oxygen in purification; and he was not appreciably shaken by the efforts of an opposition which, to say the least of it, did not convey the impression of being utterly devoid of prejudice. The paper on the use of Weldon Mud by Dr. J. J. Hood and Mr. A. Gordon Salamon was a work of art—authoritative, picturesquely phrased, and suggestive in a high degree. The papers on settings of inclined retorts and their working, and mechanical aids to retort-stoking, by Messrs. G. Winstanley, J. F. Braidwood, and C. C. Carpenter, were all creditable to the authors and the Institution, and were well discussed. Taking it altogether, Thursday was a day well spent, from the point of view of the gas engineer in council.

When it was announced that the Friday would be appropriated to a visit to the Beckton works, it must be owned that the proposal seemed wanting in originality. Beckton has been visited more than once before by associated gas managers; but this time there was greater promise of novelty in the proposed visit than at first met the eye. We gladly admit that "Beckton Revisited" in the present year of grace is a very different subject for discussion from Beckton as it appeared during the long years when the practical necessities of the gas maker were painfully overtaking the grandiose conceptions of the designer of this vast establishment. There have been many important changes at Beckton in recent years, and it is literally true that, between them, Mr. Trewby and Mr. Methven are making a new place of it, aided by an able and devoted band of assistants whose good fellowship among themselves, and loyalty to their chiefs, is a pleasure to see. There will always be something about Beckton to powerfully impress the imagination. It is such a hive of industry, the long perspective of the retort-houses and holders is so imposing, distances are so great, and the river frontage is so striking, that even the gas engineer most conscious of the defects of the original design, regarded from a technical standpoint, is apt to speak respectfully of The Gaslight and Coke Company when face to face with this vast creation of theirs. Take it for all in all, Beckton is a wonder of the world, and it must be a source of legitimate pride for any man to be entrusted with the management of such a place. We only give utterance to the sentiment of all his visitors of last Friday in expressing the heartfelt hope that Mr. Methven may long be spared in health and strength to do his heavy, but most honourable and enviable, duty in this grand sphere of action!

It is not possible to dwell here upon the new things noticeable at Beckton just now. Friday's visitors were shown a second jetty in course of construction, at which coals are to be discharged not only for consumption

on the works, but also for transhipment to the up-town stations, which will be a great economy. The jetty is being built of cast-iron cylinders, sunk down to the chalk by the compressed air system, and afterwards filled with concrete. This work is being done by Messrs. Head, Wrightson, and Co., Limited, of Stockton, who are giving the Company every satisfaction. Then there is a new double retort-house, to make 10 million cubic feet of gas per day, just being completed for use during next winter. This is a most admirable piece of work. It occupies ground in the forefront of the station which was formerly a green, with a clock-tower in the middle. It is a significant circumstance that this house, which was designed for inclined retorts, is now being filled with horizontal settings of nines, fired by simple regenerative furnaces. The adoption of the side-by-side principle of retort-house design is also worthy of mention. Stoking machinery will be adopted here eventually; but the pattern is not yet decided upon. The complete section of which this house is to form part will be a 30-inch works (to speak by the size of the connections), independent and self-contained. The exhausting machinery is by Donkin and Co. The purifiers are all ready, and are at present being used for the water-gas plant, of which more anon.

From the new section the visitors were conducted to trucks fitted for their reception, and were taken all over the works system of railways; thus being enabled to see everything that was going on inside and outside the retort-houses with the least possible fatigue. Never was Beckton more easily surveyed. The trip ended by the great out-door coal heap, which was being eaten into by a steam-navvy and a steam-grab, and will now be cleared away preparatory to taking in a new season's store.

The much-talked-of water-gas plant at Beckton is housed in a substantial building, and comprises twelve sets of generators after the improved Lowe pattern, each nominally capable of producing half-a-millon cubic feet of gas per day. Last winter, with an inferior oil, the total output of the section was 5 millions per day; but the full productive duty is expected to be attained next winter from the better oil now in use, the stores for which are very prominent in the Beckton landscape. Not all the generators are now working; the make of carburetted water gas, of from 23 to 25 candle power, being about one-eighth of the total output of the station. This gas costs, as was stated to the meeting, about 2s. per 1000 cubic feet in the holder. So far as could be seen, the working of the generators was perfect. It is ideal gas making, as compared with the ordinary process. Six-minute "blows," and gas making, are the rule; the alternations being the work of a moment, and effected by lads with the minimum of exertion. Clinkering, which is done every twelve hours, must be much rougher work; but it is nothing like so severe a labour as tending a direct-acting retort-furnace of the old type. Every hour the producer is opened, and a truckload of coke tipped in, which takes a minute. The rest of the work consists in opening and closing the valves. This plant was laid down by Messrs. Humphreys and Glasgow; and it is understood that since this job was finished several small but by no means unimportant improvements have been made by them in this type of carburetted water-gas apparatus.

After a passing glance at the new holder, which dwarfs the old row of single-lifts that originally, with a fine contempt for expense, bordered the site of the works, the visitors were conducted to the so-called "barracks," erected by the Company as a provision for meeting the labour troubles which have happily been spared them. There is accommodation here, within a stockade, for 3000 men and officers, with bedding and all necessaries at hand or in store. Here, in one of the sheds, a capital luncheon was provided for the party, by the generosity of the Directors, who really deserve the best thanks of the Institution for the exceptional way in which they are encouraging the organization. A letter from the Governor of the Company (Colonel Makins), apologizing for his inability to be present, was read from the chair; and the cordiality of its expressions in regard to the Institution was most gratifying.

Luncheon over, the party took their places in brakes at the gate, and drove to Epping Forest, which was a most agreeable conclusion of a busy and enjoyable week. The drive and high tea at the Forest Hotel, Chingford, were provided by the President; and although it is impossible to say that anything in this way that Mr. Methven might do could enhance his popularity among his professional brethren, it is due to him to state that this evidence of his unaffected kindliness of heart was fully appreciated.

It should be recorded that Wednesday night's dinner at the Holborn Restaurant, although not largely attended, was extremely well arranged and enjoyable. The guests of the Institution were Dr. W. Odling, Professor Rücker, Professor Lewes, and Mr. Salamon. The smoothness with which all the week's arrangements went off reflects the highest credit upon Mr. Thomas Cole, the Secretary of the Institution.

REPORT OF PROCEEDINGS.

The General Meeting of the Institution was held last Wednesday and Thursday, at the Institution of Civil Engineers, Great George Street, Westminster.

Mr. CHARLES HUNT, the retiring President, occupied the chair at the commencement of the proceedings.

ANNUAL REPORT AND ACCOUNTS.

The report of the Council (given in the JOURNAL for the 2nd inst.) and the statement of accounts were taken as read; and, on the motion of the CHAIRMAN, they were received and adopted.

NEW MEMBERS AND ASSOCIATES.

The Scrutineers reported that the whole of the gentlemen in the following list had been elected:—

MEMBERS.

Carpenter, W. J., Engineer, Gas-Works, Great Yarmouth.
Chamberlain, H. B., Engineer, Gas-Works, Holywell.
Packham, H. F., Engineer, Gas-Works, Kingston-on-Thames.
Pye, T. E., Assistant Engineer, Gas-Works, Shrewsbury.
Smythe, H., Engineer, Gas-Works, Maidstone.
Walker, W. A., Engineer, Gas-Works, Worthing.
Wright, W. B., Engineer, Gas-Works, Bromley-by-Bow.
Wright, F., Assistant Engineer, Gas-Works, Bromley-by-Bow.
Wilton, T., Manager, Products Works, Beckton.

ASSOCIATES.

Smith, A., District Engineer, Gas-Works, Glasgow.
Taplay, J. G., Assistant Engineer, Gas-Works, Stoke-upon-Trent.

The CHAIRMAN said this concluded the business of his official year; and it was now his pleasurable duty to yield the chair to his successor. Mr. Methven needed no introduction from him; but he might be permitted to say that this was an occasion of peculiar interest and satisfaction to him. More than twenty years ago, Mr. Methven and he were associated together in the management of his present works in Birmingham; and for many years he was connected with the works in London where he (Mr. Hunt) served his apprenticeship under Mr. Morton. He was quite sure that, under the presidency of Mr. Methven, the Institution would take an important step forward.

Mr. METHVEN here took the chair.

THANKS TO THE PAST-PRESIDENT.

Mr. W. KING (Liverpool) moved that the best thanks of the members be given to Mr. Hunt, the retiring President, for his conduct in the chair during the past year. When Mr. Hunt was elected, everyone felt sure that in his hands the rights of his office would be well maintained; and at the conclusion of his term, they would all agree that their expectations had been fully realized. He only expressed the feeling of the meeting in offering Mr. Hunt their best thanks, not only for his official services, but for the kindness he had shown in giving the members, at great personal cost and inconvenience, a most instructive inspection of the apparatus at the Birmingham works.

Mr. G. E. STEVENSON seconded the motion.

The PRESIDENT, in putting the proposition to the meeting, endorsed all that Mr. King had said; and expressed the hope that he (Mr. Methven) would be equally successful in following in his predecessor's footsteps.

The motion having been carried unanimously,

Mr. HUNT, in acknowledging the vote, observed that he had endeavoured to do his best to further the interests of the Institution; and he was glad to know that, at the termination of his year of office, it had increased in strength, both numerically and financially. If he had in any way contributed towards this end, he was more than repaid for his labours.

The PRESIDENT then delivered the following

INAUGURAL ADDRESS.

That the task of delivering a presidential address is one enveloped in difficulty, cannot be disputed; for since we heard the admirable address of my predecessor, who has just vacated the chair, the gas profession has had the opportunity of digesting some ten or twelve presidential utterances, which, although delivered in different centres, have all been reported in current literature of the day. To steer clear of plagiarism is not one of the least difficulties which presents itself at the outset. To be original in the face of such an array of technical *résumés* of affairs of current interest to our profession, is practically impossible; and to run the risk of being considered pedantic is almost sufficient to create an insurmountable obstacle. As President of your Institution, however, I have the customary duty to perform; and, while hoping to be successful in surmounting the difficulties I have mentioned, I trust, by making my references as brief as possible, I may be equally fortunate, in delivering the few remarks I intend to make, in not altogether exhausting your patience.

Your Institution is now in the third year of its existence; and its growth must be considered by everyone connected with it to be highly satisfactory. Starting as it did, in 1891, with 73 members, the close of 1892 found 115 members enrolled; and this number has increased during the present year to 139. The amount of work got through at the two annual meetings is evidence beyond contradiction of the deep interest taken by the members generally in the success of the Institution. The number of papers provided for our consideration at each meeting is an indication that we possess a high percentage of working members. Lastly, there is the fact that, at the close of the year, we had not a single instance of a subscription being in arrear. Stronger evidence than this, of the general desire to make a successful career for this Institution, cannot be produced.

The last two or three years have been serious times for the manufacturers of gas. Troubles have arisen in many directions—troubles with labour, troubles in obtaining supplies, and troubles in disposing of our products. But the year 1893 opened with prospects of a more cheering nature. We were promised coal at a cheaper rate; and this has been as fully realized in the Metropolis as elsewhere. It has been stated in the Press that the supply to a large town in Scotland has been purchased at a reduction of from 23 to 25 per cent. on last year's prices. If this is the case at one place, it is probably an indication of the general benefit to be experienced throughout the country. Great hope may be reasonably entertained that the present condition of the products market is the bottom of the wave of depression, and that as the year advances a considerable improvement will be marked. Tar products, I am glad to observe, are already advancing in value. Our products being so much influenced by the condition of the general trade of the country, it is perhaps idle to hope for any lasting improvement in this respect until a revival occurs. But even with products remaining at their present low value, and with such a manifest reduction in the price of coal, it may with certainty be said that better times are coming, and that they are near at hand.

Synchronous with the troubles above referred to, electric installations in the Metropolis have been gradually and steadily developing; and a large amount of capital has already been expended. Up to the present time, the district on the north side of the river is the one most affected by these installations; and it is interesting to note to what a small extent the electric light has interfered with the consumption of gas supplied by The Gaslight and Coke Company to that district. As a matter of fact, in January last the record of the maximum average weekly consumption was broken when the mean consumption for the first week in the month, and excluding Sunday, reached very nearly the large amount of 105 million cubic feet per day. Single day consumptions have exceeded this figure; but never before has the weekday average for a week touched this amount. Diagrams indicating the weekly averages of gas consumed throughout the years 1890 and 1891, and as much of 1893 as possible, show how much the consumption is influenced by changes in the thermometer.

It may be of interest to note, from some figures which are before me, that the average daylight hourly consumption in January, 1893, was 22·8 per cent. higher than it was in the same period of 1889; while the average hourly consumption during the four hours of heaviest lighting in 1893 was 0·25 per cent. more than in 1889. We have thus the source of our increased consumption clearly demonstrated. The ratio of increase not being the same in each case, it follows that the average daylight hourly consumption is only 32·5 per cent. of the average hour of heavy lighting in 1889; while in 1893 it is 39·8 per cent. A similar comparison has been made during the month of July, and with results closely following the above figures. The extent to which the consumption of gas of The Gaslight and Coke Company has been affected by the introduction of the electric light will thus be seen, and also how judiciously the Company have developed their opportunity of increasing the daylight consumption.

I have prepared an analysis of the consumption of gas supplied by the three Metropolitan Companies for the week ending March 19, 1892, which are comparable, as the same description of weather prevailed in each district. The total daily consumption of gas in each has been split up into three portions: (A) From 6 a.m. to 6 p.m., representing daylight consumption; (B) from 6 p.m. to 12 midnight, representing heavy lighting; and (C) from midnight to 6 a.m., representing night light consumption. The figures are as follows:—

	A.	B.	C.
Chartered.	37 per cent.	54 per cent.	9 per cent.
South Metropolitan. .	28 „	60 „	12 „
Commercial	29 „	59 „	12 „

The large percentage of day consumption of the Chartered Company is very marked, and means that a large quantity of gas is used for cooking and heating, as well as for producing power. It is therefore not surprising that this year, with its early advent of spring and summer, should have influenced the daylight consumption of gas, and consequently account for the slight decrease in the general consumption observed. But the weather this spring has been exceptional; and we shall, in all probability, have a return of our usual British weather, bringing with it its demand for a supply of gas to warm and cheer the Britisher who has to endure it.

The necessity for increasing the daylight consumption of gas ought not to be overlooked. Efforts should be made in every direction for developing it. Every additional foot of gas sold during the daytime costs us no additional charge for distribution or for storeage on the works; and considering the heavy proportion of our capital expended on mains, services, meters, and gasholders, which to a great extent lie dormant during the greater part of the 24 hours, it "goes without saying" that the development of a daylight use for such plant is the right step for a company to take.

The great desire of gas manufacturers should be to provide gas of a composition as pure as practicable; so that, as it is so much used for cooking and heating, the products of combustion should be as free from deleterious matter as possible. It must be a subject of regret to many who hold these views that a large Company, supplying a beautiful residential neighbourhood, should be seeking to obtain parliamentary powers to deliver gas containing 30 grains of sulphur. Any excess of, or even an approach to, the amount allowed is easily recognized by one who has been associated with the use of gas freed from its sulphur impurities to the statutory requirements of the Metropolis, especially if the gas is used in a room with deficient ventilation. The unpleasant experiences of inhaling the atmosphere of a room thus supplied are lasting in their character, and bear forcible evidence of the necessity at all times for removing to the greatest extent the sulphur compounds. There are few responsible for the conduct of a gas undertaking who do not advocate taking the whole of the carbonic acid out of the gas; and there are few, if any, who believe in its complete removal without recourse to the use of lime. If, therefore, a system can be adopted whereby the sulphur compounds can be removed with the same material, and without the use of any additional quantity, the question of expense cannot be supported. With a good system of purification—and one certainly does exist—the removal of the lime which has dealt with the sulphur compounds may be effected with very little more nuisance than the resultant material if used alone for the removal of the carbonic acid.

A very popular impression is prevailent among our

consumers generally, and it has been referred to when the advantages of the electric light have been extolled by its advocates, that blackened ceilings will be abolished by discontinuing the use of gas. This, however, will not be the result, because the blackened ceilings are not produced, as is supposed, by the deposit of the products of combustion. But I am afraid I am dangerously near the line of plagiarism. This has been explained before. Possibly the Statute of Limitations may intervene; and I may be permitted to recite it. I have recently observed immediately above a hot water or steam radiator, fixed in a large hall close to the wall, a fearful patch of blackened space. I have also observed, in a room with gorgeous embellishments, immediately above a cluster of incandescent electric lamps, although in a modified form, the same condition of affairs. As there are no products of combustion from either the radiator or the incandescent electric lamps, the cause of the blackened space must be due to the heat inducing a current of the dust-laden air of the room to impinge upon the wall; and in proportion to the heat evolved, by either the radiator, the gas-burner, or the incandescent cluster, so is the intensity of the blackened space on the wall.

To revert for one moment to the question of the necessity of perfect purification. A celebrated maker of gas-fires was consulted by a purchaser who wanted one arranged possessing all the conveniences of the best of gas-fires, but without the forcible reminder staring him in the face continually that it was gas he was using. Nothing would satisfy this gentleman but an arrangement whereby the position of the usual gas-burners in the front of the stove should be altered to one under the grate, and so keep them from sight. The fire on these lines was fixed. But what with a possible obstruction caused by the bottom of the grate, perhaps augmented by a chimney deficient of natural uptake power, the fire was not a success; and this was marked in the most unpleasant manner possible. The burners fixed in their new position did not act as injectors of air to the interior of the stove, as they always do when placed in front; and consequently the combustion of the gas was not perfect. Sufficient heat was, however, generated to demonstrate in a practical way the pretty laboratory experiment of decomposing the sulphur compounds in coal gas, by passing it over heated material, and converting them into sulphuretted hydrogen. The unpleasant character of this gas was experienced to such an extent that you will not be surprised to hear that the fire was very quickly removed. Gas purified to the utmost possible limits would, if dealt with under the conditions above related, prove itself objectionable; but the production of the noxious sulphuretted hydrogen would have been in proportion to the amount of sulphur in other forms present in the gas.

Another instance of the lack of care in the matter of purification was experienced during last year in a rapidly-growing town not an hour's journey from London, when, from over-zeal on the part of the works foreman, an excess of air was drawn in with the gas to such an extent as to ignite the oxide in the purifiers. This being rather rich in sulphur, the latter was transferred into the gasholders. For two or three days, the inhabitants of that town were thoroughly disinfected, especially those who were compelled to burn their gas indoors. The result of the combustion of this gas passed all my experience. I never thought it possible for such an amount of sulphurous acid to be produced. In fact, the only approach to this result could be obtained by a brazier and a pan of brimstone.

Both of these cases have been referred to with the object of emphasizing the necessity for complete and perfect purification of the gas before delivering it to the public, and also to show how seriously unobserved in some instances is the importance of such ample purification. Attention devoted to this point will tend considerably to hold in check the progress of the electric light; and companies supplying provincial towns, who have not found the adoption of complete purification necessary, ought to be wise in time, and adopt means at once to remedy this state of affairs.

In carbonizing coal there is little of novelty to relate. In order to meet the additional candle in illuminating power of the gas supplied to the Metropolis which was imposed on the Companies in the alteration of the photometers by the Referees, the Metropolitan Companies have largely had recourse to the use of oil as an enricher; and the manufacture of carburetted water gas is the principal means adopted by one of the Companies. Its use has been instrumental in bringing the abnormal price that cannel assumed two years ago, down to its proper level; and thus, by the action of The Gaslight and Coke Company, many have benefited. Carburetted water gas of 25-candle power can now be made at a cost not exceeding 2s. per 1000 cubic feet in the holders, which includes a liberal amount for wear and tear of plant; the oil costing 3¼d. a gallon, and the coke 10s. 6d. per ton. This cost of production will, it will be agreed, make carburetted water gas a powerful competitor with cannel gas produced in the Metropolis. It has thus established for itself a permanently installed position in the manufacture of London gas; for the requirements of enrichment have entailed the use of so large a quantity of material that, if cannel were entirely resorted to, the probability would be that the supply would not equal the demand, and a rapid rise in price would be the inevitable result.

In 1889, when reviewing the actions of the Metropolitan Gas Referees in altering the photometers which had been in use for years for determining the quality of London gas, I predicted that the Metropolitan Gas Companies would not be able to procure coal of a sufficiently good quality to meet the demands; and so it has turned out. Gas companies were forced to look for another source whence to obtain their enricher; and the result is that oil has been largely and profitably used in the manufacture of gas. Some idea can now be formed of the magnitude of the injustice inflicted on the London Companies by this action of the Referees. Field's "Analysis" informs us that for the year 1888 the cannel necessary to be used in the Metropolis was 1·42 per cent.; in 1889 it was 2·26 per cent.; while in 1890 the percentage increased to 3·58—showing an increase of 252 per cent. in the proportion of cannel employed in the period of two years. In cannel used, these percentages represent, in 1888, 36,257 tons; in 1889, 60,408 tons; and in 1890, 100,282 tons. This shows that in two years there has been an increased employment of cannel to the extent of 64,025 tons. By this use of cannel, common coal was displaced to a like extent; and the difference in their cost will represent the extra amount expended by the Companies. Taking the figure at 17s. per ton, we have the good round sum of £54,000—an amount which would increase 6d. per ton the total cost of coals used in 1890. It is very questionable whether the Metropolitan consumers are any the better for the change in the quality of the gas; for this imposition is one of the causes of the dear gas of to-day.

Definite information as to the best and most economical system of carbonizing is still wanting. Sloping retorts have been introduced here and there; but, as yet, no figures indicating their cost of construction and their maintenance are before us. It is hoped, however, that the three papers on this subject which we are to consider at this meeting will clear up that which at present is obscure, and that the balance of opinion will decide the question whether inclined retorts, or horizontal ones, worked by power, are to be the retorts of the future. I have obtained some figures relative to the expense of an installation of sixteen beds, each containing nine retorts 15 feet long, and set at an angle of 38°, which indicate that the cost of construction of arches, furnaces, and settings, for brickwork and retorts alone, amounts to £355 per bed, or a little more than 52s. 6d. per lineal foot of retort. Similar figures for the erection of a bed of nine horizontal retorts, 20 feet long, would amount to £211, or about 23s. 6d. per lineal foot of retort. As to maintenance, the life of an inclined retort has been found to be about one-half that of a horizontal one. The figures here given may be, perhaps, incidental to the style of setting; but, regarded in their full light, their importance must not be overlooked when comparison is made of any saving in labour which may be attached to the system.

The extraction of cyanogen from coal gas, in a form suitable for the manufacture of Prussian blue, is a novelty in gas manufacture possessing considerable interest at the present time, when the value of residual products has declined to such an extent. The system which has been introduced by Mr. Wilton, the Manager of The Gaslight and Coke Company's products works, has been in operation with success at more than one of the Company's stations; and the members, when visiting Beckton

on Friday, will have an opportunity of inspecting this process. It will be sufficient to say, therefore, that the cyanogen is arrested in the primary process of scrubbing, by adding to the usual contents of the washer a proto-salt of iron. Ammonium ferro-cyanide is consequently produced in the washer; and the solution is then removed to the products works, where, by a special process, the Prussian blue is obtained. With the ordinary process of scrubbing and washing, the cyanogen was incorporated with the liquor as sulpho-cyanide and was not recovered. In years gone by, when the value of the complete removal of the ammonia from the gas by the scrubbers was not fully appreciated, Prussian blue was found in sufficient quantity to pay for its extraction from the spent oxide of iron; but the advent of lime purification on the one hand, and complete ammonia purification on the other, soon reduced the quantity, so that its extraction was no longer remunerative.

Purification has been the subject of comment during the past twelve months; and great interest is involved in the relative advantages of incorporating with the various systems in use pure oxygen or atmospheric air as an auxiliary to their efficiency. I have had experience of working the two systems most generally adopted for the reduction of the sulphur compounds—No. 1, the use of consecutive lime purifiers; and No. 2, the use of independent sulphide vessels (with the first system is incorporated the use of a measured volume of air). A careful observation of the progression of the carbonic acid, the regulation of the oxidizing influence of the air on the sulphuretted hydrogen, and with recorded notes taken from time to time of the relative position of these impurities in the series of purifiers, are all that is necessary to make the manipulation of this system simple, and thoroughly trustworthy. The only objection to it is said to be in the loss of sulphur, which in the second system is to a certain extent recovered. I find, however, that the value of this recovery only amounts to about a halfpenny per ton of coal used. It would be impossible to adopt the second system in works situated in a populous neighbourhood, especially where nuisance has to be avoided; for the lime is at all times indifferently carbonated, and when it is necessary to change a sulphide vessel—well, to put it mildly, it is the most abominable operation imaginable.

This address would certainly be incomplete if no reference were made to the completion of the gigantic gasholder at East Greenwich. The question which gave rise to doubt in many minds has now been well proved—that it is possible to float a holder and work it satisfactorily with two out of six of its lifts free from the support of guide-framing. The pioneer of this movement merits our hearty congratulations on the completion of this leviathan. The only point now to be proved is the durability of the structure. Completed about the same time on the other side of the river, is a holder which rises as high as its opposite neighbour, but which has the support of guide-framing to the top. As time rolls on, it will be interesting to watch the effect of wear and tear on the two structures. There can be little doubt that the torsion of the plating of the unprotected holder must be greater than that of the fully-supported one; and, if this is admitted, time only can prove the effect produced on the material of which it is constructed.

It is not improbable that, before long, the work of the Commission now sitting to consider the question of the introduction of a standard to supersede candles for testing gas will result in an application to Parliament by the Board of Trade for an Act to legalize it; and, although the new Act may have special reference to the Metropolis, it is possible that its provisions may apply to the country generally. It is therefore highly necessary for this Institution, representing as it does such vast interests, to watch the proceedings carefully, and, if necessary, to take steps to secure *locus standi*. There is no doubt that the gas-testing arrangements, as they now exist in the Metropolis, are of a very unsatisfactory character. The powers at present vested in the Referees must be more clearly and definitely defined. The form of photometer, and other apparatus used, must be specified in the new Act; and thus prevent the necessity for the Referees to alter "from time to time" the apparatus to be used. The Referees should be a representative body, representing alike the interests of the consumers and the gas companies, and holding a perfectly neutral and unbiassed position. The examiners should be removed from the domineering influence of the County Council, and be placed under the authority of the Referees. In fact, the whole system requires reconstruction.

With regard to the process of testing, the present Act gives the company's representative power to be present at each testing; but it is contended that he has only the right to be present, and must not interfere in any way. He cannot satisfy himself that the apparatus is correct, neither can he check the examiner's readings of the disc. This interpretation of the Act was surely not intended. Justice to the companies can only be done by making a provision that each testing-place should be provided with a small gasholder, through which the gas to be tested should pass; and thus, after each testing, it could be arranged that a sample of gas should be left in the holder for subsequent verification by some duly appointed and independent person, chosen jointly by the gas companies and the public authority. Thus in the case of an alleged deficiency, the question could be settled in a satisfactory manner to all concerned. The construction of the meter which is at present used and certified by the Referees is not so perfect as it might be. One is required with a fixed overflow, having a reservoir and a bird-fountain attached, to afford provision for a continuous flow of water through the instrument when it is in operation. Meters with this provision, when once certified to be correct, could at all times be depended upon to give correct registration. It would also dispense with the necessity which at present exists for their regular verification by the Gas Examiners. The thermometers also require to have their bulbs immersed in the water, to record the correct temperature of the measuring chamber of the drum. Another point which requires attention is fixing the temperature of the testing-room and apparatus. This factor is of the greatest importance, and it is one which has hitherto been disregarded. Provision should be made for keeping the temperature constant throughout the whole year; and as it is more difficult to cool the room in summer than warm it in winter, the limit of temperature should be not lower than that experienced in the warmest month of summer. The temperature should be determined by recording thermometers, and no testing be considered valid if made under the specified limit.

My opinions with regard to the burner employed are still the same as those I expressed in 1889; and the more consideration I give the subject, the more I am convinced of the necessity of a radical change in the system of photometry. The fact that any and every burner is, to a degree, more or less affected by the varying changes of the atmosphere, cannot be disputed. It is therefore of the utmost importance that this variable factor should be eliminated from the operation of testing. It is notorious that photometry, as now practised, is destitute of the ordinary rules of practical science. A chemist, before starting on the most simple quantitative analysis of a substance, will work on a perfectly dried sample, by evaporating its moisture; and if his work involves the measurement of a gas, he would not think of proceeding without abstracting its aqueous vapour. In fact, such abstraction of moisture is the A B C of practical chemistry. If this is the case in one branch of science, why should it not exist in another? Why should not the measurement of light be equally scientifically executed? and why should not the disturbing factor of aqueous vapour be removed before commencing its determination? It is true that the range of error which operates from this cause in the present system will be modified by the enlargement of the power of the suggested 10-candle standard; for the comparison will be made against a flame of comparatively equal power, and the conditions which operate on the one will operate on the other. But this, although it is an improvement, is not all we want. To enable us to measure accurately the light-giving value of a flame, the gas which produces the flame should be divested of its aqueous vapour; seeing that this element varies from hour to hour. It is equally necessary that the flame should be consumed in an atmosphere of dried air; and, seeing that the quantity of air inducted into the burner is of such a varying quantity, governed by temperature and barometrical pressure, my contention is that the burner should be provided with a controlled supply of dried air, and with a corrected volume to suit the temperature and pressure for the time being.

It will be at once seen what a boon this arrangement would be to the gas maker. Under the existing method of testing, the gas made and stored to-day may be consumed and tested under very different atmospheric conditions to-morrow; and the manufacturer is helpless to alter the constituents. But if it is made to-day under the conditions it is sought to introduce, and which I have endeavoured to explain, it will be tested to-morrow under similar conditions, and the gas will measure out exactly as the gas maker produced it the day before. I maintain that, in these days of competition, when every fraction of a penny in the cost of 1000 cubic feet of gas sold is of importance, it is necessary that the measurement of the quality of the gas should be determined with the greatest possible accuracy, that the disturbing factors in the science of photometry should all be removed, and that the gas maker should be placed in a position so that he can work independently of all chance; and I think this can only be done in the way I have indicated. I can well understand certain of the members who have the responsibility of supplying some of our provincial towns with gas expressing a doubt as to the necessity of elaborating the system of gas testing; but those of our number who have had recent experience of the *modus operandi* in London will, I am sure, readily appreciate the advent of any change calculated to remove the uncertainty attending the existing system.

Before closing, I have one or two duties to perform. First I have to tender my thanks to the members for electing me to the honourable position of President—a position I accepted with an ominous fear that the duties attached to the large concern of which I have the management might render me not the most suitable man for it. Having accepted the responsibilities, my desire will be to see that the interests of the Institution will suffer in no degree during my term of office. In this, I hope to have the cordial assistance of the Council and members generally. My next duty is to thank you for the patient hearing you have given my remarks, which I regret have not had reference to questions of more general interest. I have made little reference to the subject-matter of the papers we have to consider at this meeting; but the debatable subjects with which each deals will, I am sure, create discussions which will prove to be not the least interesting part of our *agenda*.

Mr. G. Livesey said he had great pleasure in moving a vote of thanks to the President for his address. It was a difficult matter now-a-days for a President to write an address; but those who had had the privilege of hearing the one just delivered must have felt that it contained matter of very great importance to gas makers.

The motion was carried by acclamation.

Students.

The President remarked that the next item on the *agenda* was a proposition concerning students. All that it was necessary for him to say was that a class of students had been started; and the desire of the Council was simply to notify this fact to the members generally. He expressed the hope that more nominations would be received to increase the number of this class, and further to ask the members to afford all possible facilities for students to visit their respective works, whether in the Metropolitan district or in the country.

Reading of Papers.

The reading of papers was then commenced. They were taken in the following order:—

Wednesday.—(1) "Differential Prices for Gas." By G. Livesey. (2) "Carburetted Water Gas." By Vivian B. Lewes, F.I.C., F.C.S. (3) "Carburetted Water-Gas Apparatus." By A. G. Glasgow.

Thursday.—(4) "Notes on the Application of Oxygen to Lime Purification at Shrewsbury." By W. Belton. (5) "The Application of Weldon Mud to Gas Purification." By J. J. Hood, D.Sc., Assoc.R.S.M., and A. Gordon Salamon, Assoc.R.S.M., F.I.C. (6) "Inclined Retorts at Coventry." By Geo. Winstanley. (7) "An Improved System of Working Inclined Retorts." By J. F. Braidwood. (8) "The Application of Machinery for Working Horizontal Retorts." By C. C. Carpenter.

The first four of these papers are given in another part of the Journal; the remainder, with the report of the discussions, being held over for subsequent issues.

At the close of the discussions on Thursday afternoon, the general business was resumed.

Appointment of Scrutineers.

The President said the next matter was to elect Scrutineers for the current year. The Institution had been ably served by Messrs. Lacey, M'Minn, and Tysoe; and he would suggest that they be re-elected.

Mr. May moved a resolution to this effect, which was seconded by Mr. Paterson, and carried unanimously.

Votes of Thanks.

The President then moved—"That the best thanks of the meeting be accorded to the President and Council of the Institution of Civil Engineers, for the use of the rooms of the Institution for the purposes of the meeting." He said he did not know what they should do if it were not for the kindness and liberality of the Institution of Civil Engineers; and he only regretted that the benches had not been better filled. He hoped, however, that in future years there would be an improvement in this respect.

Mr. T. B. Ball (Rochdale) seconded the motion, and it was carried unanimously.

Mr. Hunt then proposed—"That the best thanks of the meeting be accorded to the President for his conduct in the chair." He remarked that they had had a most successful meeting, and that its success had been very largely due to the President's urbanity and tact in the conduct of the business. If the attendance had not been so large as on previous occasions, it might be accounted for by certain counter-attractions; and he could only say he had never attended a meeting of the kind at which the opportunities for discussion had been more ample.

Mr. C. E. Botley (Hastings) seconded the motion, which was cordially agreed to.

The President said he was much obliged by the manner in which the flattering remarks of Mr. Hunt had been received. The work of conducting a meeting of this kind was quite new to him; and he was pleased to find he had given satisfaction.

Mr. A. F. Browne (Rotherhithe) next moved—"That the best thanks of the meeting be accorded to the Council of the Institution for their work during the past year." He said he ventured to think that a seat on the Council was no sinecure; for upon them devolved the responsibility of the steps to be taken to support the dignity and enhance the usefulness of the Institution as a public body. This was not the only organization of the kind. There was not only The Gas Institute, but there were local and district Associations in all parts of the country, doing good and useful work; and the responsibility on the Council of the Institution was therefore all the greater. Many of the members had to come from distant parts of the country; and their duties, therefore, involved considerable personal inconvenience. Like all unpaid public servants, they were rewarded in two ways—first by a knowledge of the excellence of the work done to further the interests of the gas industry both from a scientific and a commercial point of view; and next by a knowledge that their efforts were appreciated by the members.

The motion was carried unanimously.

Mr. C. C. Carpenter (Vauxhall), on behalf of the Council, acknowledged the vote. He said that, like all other people, they only possessed human constitutions, and could not always do all they wished. But their heart was thoroughly in the work; and if they did not succeed, it was not from want of endeavour. He wished to make one remark with regard to the students. The Council, in discussing the ways in which the usefulness of the Institution might be furthered, laid great stress on this point. The student of the present day would be the hard-working gas engineer of the next decade; and everything they could do to render him better fitted to perform his duties when the time came, would be to the advantage of the industry. The idea was to put every pupil and every member of the Institution in touch with the Secretary, so that, by the simple means of writing to him, he might obtain the *entrée* to any works he might desire to visit. If the members would do what they could to carry out this idea, it would be one of the best ways in which to express

their thanks for anything the Council had been able to perform.

Mr. MAY moved a vote of thanks to the Secretary. As a member of the Council, he said he could speak to the thorough way in which he carried out his duties; he was a most valuable officer, as all the members were aware.

The PRESIDENT expressed his pleasure in seconding the motion, which was at once carried.

The SECRETARY said he had met with nothing but kindness from everyone with whom he had come in contact since he had had the honour of being Secretary; and therefore his work became a labour of love. As long as he remained in office, it would be his pleasure to discharge his duties to the best of his ability.

The proceedings then closed.

PAPERS READ AT THE MEETING.

DIFFERENTIAL PRICES FOR GAS.

By GEORGE LIVESEY.

Although the title does not exactly correspond with the subject upon which it was proposed this paper should be written, I hope and believe it will prove to be a better foundation for an interesting and useful discussion.

The times are changed, not less for gas makers than for others. Active competition has taken the place of the old sleepy days of protected monopoly, when the practice was to sit still and wait for whatever might come; and, as the general result was an annual increase of some 10 per cent., there was no stimulus to exertion. Cheap mineral oil on one side, and dear, but attractive electric light on the other, however, have given a practical illustration of the meaning of a "decremental rate of increase," which may by progression or retrogression in the same direction, unless the sleepy conservatism of the past be shaken off, still further add to our knowledge by teaching us the meaning of an incremental rate of decrease. So far as I can see, it will be our own fault if we should have to learn this novel lesson.

The most important and enduring link in the golden chain that binds us to continued prosperity is justice; and it has doubtless been from a desire to deal justly that differential prices have been introduced. On this foundation alone can they stand. Their adoption from mere expediency, if their incidence is not fair, must lead to trouble and failure in the end. Their true object is to hold the scales fairly between consumer and consumer, neither the small nor the large consumer—neither the user of gas for light, nor he who uses it for heat or power—should be supplied at a lower price than any other consumer or user. But the difficulty is to apply the principle. It is certainly not applied where there is a fixed and uniform price, where the large consumer actually pays more for his gas than the small one. Neither is the principle fairly applied where heavy discounts are allowed to the large consumer. The price of gas includes something beyond the cost of manufacture and interest on capital. It is on this alone that differential prices for gas used for *lighting* are justifiable, and therefore necessary. The difference, however, is not much, since it rests mainly on the expenditure on clerks, inspectors, and collectors, with the possible inclusion of bad debts.

There is, however, some further difference between consumers who use gas for lighting only, and those who require it for other purposes in equal quantities throughout the year; though there is not the difference that some suppose between day and night gas. It is true that in this case the mains that have been provided at the cost of the consumers who use night gas, can be used for the day consumers; but is it fair to allow them to have the use of the mains for nothing? Therefore any reduction that can be made by such use of the mains ought at the very least to be shared by both classes. If on this ground the day consumer is supplied at a reduction, the night consumer is treated unjustly, and has solid ground for complaint.

As to gasholders, there is a slight difference in the argument, though they also have been provided at the expense and for the use of the night consumers. But it is argued that for day gas they are not necessary at all. Suppose, however, gas were consumed only in the daytime, then they would be necessary for day gas. Night helps day, and day assists night. Therefore justice requires equal treatment; and I have not the slightest doubt that in the long run such equal treatment will be found most advantageous.

One word about gas used for heating. So far from selling it at a reduction, it ought in strict justice to be charged at a higher price than gas used for any other purpose, because it is required only in the winter, and then most irregularly.

Having settled day and night, and heating gas, we return to uniform consumption throughout the year, for which it appears a just claim can be made for some abatement or discount on the regular price.

If the annual output of gas be taken at the usual round figure of 200 times the maximum day's make, it follows that, if the consumption were the same in summer as in winter, a much smaller plant would do the work. For instance, at present an annual demand of 200 millions necessitates works capable of making 1 million feet a day; but at equal daily rates, 548,000 feet a day would amount to 200 millions in the year, or very little more than half. But something must be allowed for retort-houses and retorts, which at present are largely out of use in the summer, thus affording opportunity for resetting; whereas, with a constant make of gas, a sufficient excess—probably 20 or 25 per cent.—must be provided for repairs and resetting.

At any rate, with uniform consumption, works of about two-thirds the ordinary size would give the same output; and the capital would be reduced in proportion. Therefore, when gas is so used, as in manufacturing operations and for power, and possibly for cooking, there appears to be a just claim for an abatement, not, however, as at present, of a sum equal to the interest upon the capital that would be saved (say one-third), because the proportion of the total make that is used in uniform quantity throughout the year is so small. It seems, therefore, that the justice of the case would be met by estimating the saving at one-sixth of the interest on the total capital, which in ordinary cases would be about 5 per cent. on the price of gas.

There still remains the question of a discount to large consumers. The Board of Trade returns show that such discounts are very common. Sometimes, however, a distinct difference in price is the form of the allowance; but it is rather remarkable that in these cases the difference is generally less than where a discount is allowed. It is possible that Boards of Directors and Committees have a more clear conception of values when expressed in pence rather than in the shape of a discount? Discounts of 20 per cent. to large consumers are not uncommon, and in some cases even more; but the range may be taken generally at from 2½ to 20 per cent. Where they begin at 2½, they are usually of moderate amount (5 or 7½ per cent.) for the largest consumers; but where they extend to 20 per cent., they generally begin at 5 per cent. or more.

As already stated, the difference in cost on which these differential rates can be based is small. It consists of the salaries and wages of rental clerks and inspectors, the cost of collection, and I add bad debts because it is perfectly practicable, and the best way of allowing a discount, to make it conditional on the account being paid at the office by the consumer within a month of its becoming due. If so paid, there cannot well be a bad debt; moreover, the cost of collection is saved.

By Field's "Analysis," the average amount per 1000 cubic feet sold for the four divisions of gas undertakings there set out are as follows. In the first column will be found the average receipt per consumer, which is rather above the actual fact, because the rental given in the "Analysis" includes the public lights, and the last column gives the approximate percentage of the three items named above on the price charged for gas:—

—	Average Gas-Rental per Consumer.	Cost per 1000 Cubic Feet Sold.				Approximate Percentage on Average Selling Price.
		Clerks and Inspectors.	Collecting.	Bad Debts.	Total.	
	£ s. d.	d.	d.	d.	d.	Per Cent.
3 London Companies	11 10 0	0·56	0·36	0·17	1·09	3½
12 Suburban do.	0 9 6	0·51	0·42	0·12	1·05	3
10 Provincial do.	0 5 8	0·45	0·38	0·06	0·89	3
8 Corporations*	0 4 6	0·75	0·24	0·10	1·09	3½

* There is a considerable variation in the gas-rental per consumer; it ranges from over £12 in the case of the Chartered Company to less than £3 at Leeds, Oldham, and Preston.

From this it appears that 3 or 3½ per cent. of the price of gas to the average consumer is due to these three items. If, therefore, the whole were saved in the case of the *largest* consumer, he would only be entitled to a discount of 3½ per cent., unless there are reasons why a greater allowance should be made. There is probably something saved in maintenance of service-pipes and in leakage; but it is difficult to bring up the allowance due even to the largest consumer, including the advantage of early payment, to more than 5 per cent., and proportionately less for other large consumers.

It would be both interesting and instructive to extract from the Board of Trade returns particulars as to the varying allowances and discounts. In one case, in addition to discounts according to consumption, a further allowance of 10d. per 1000 cubic feet off the price of 4s. 2d. is made for payment within 28 days after the quarter, or 20 per cent. allowed to save little more than the expense of a collector. There are also many cases of 20 per cent. discounts to the largest consumers; but these heavy discounts are rarely found in any except small concerns—the large companies and corporations generally limiting their discounts to smaller figures. But the most extraordinary system of allowances was announced in the JOURNAL OF GAS LIGHTING for May 2 (p. 797). In this case the price is 4s. 6d. per 1000 feet, and for *heating* and motive power there is to be a reduction of 6d. For the latter an allowance is right; but for the former it is not so, as already shown. But there is in addition something which the JOURNAL describes as "unique," and will very likely remain so when the effect of the so-called concession is understood. All gas burnt in excess of the consumption in the corresponding quarter is to be charged at 3s. 4d., or a reduction of 1s. 2d. per 1000 feet. Consequently, the old-established customer who has reached his maximum consumption, and who may be burning 100,000 cubic feet a year, will still have to pay 4s. 2d.; but another consumer just starting in business, who burnt last year say 10,000 feet, will, when he increases to 20,000 feet, have his total supply at an average charge of 3s. 11d., against 4s. 6d. for the man who burns five times as much. Anything more crude or unjust, and likely to cause so much discontent as speedily to render it unworkable, could hardly be conceived. But it is an apt illustration of the vagaries resulting from making allowances which have not a solid foundation of justice to support them; their only effect being to retard reductions in the price generally, and to breed an angry feeling towards the gas supplier.

If certain consumers are to be favoured, it must be at the expense of the general body, who have to pay more than is right to make up for the deficiencies of others. There may, of course, be exceptional circumstances where it is sometimes fair and advisable to make rather larger allowances than can be defended on exact lines, such, for instance, as concessions necessary to prevent the loss of such large consumers as would, if lost, detrimentally affect the business, and thus indirectly injure the general body of consumers; but it is very easy to go too far in this direction, and exceedingly difficult, if not impossible, to draw back. It is surely best to adhere to a line of strict justice. This will satisfy all reasonable men; and, as to those who are unreasonable, the plan most conducive to peace of mind is not to try to satisfy them, for failure is certain.

Large consumers certainly and rightly feel that they have a just claim for a moderate discount. I have found them perfectly satisfied with a maximum discount of 5 per cent., coupled with the condition of payment within a month. This reasonable concession has, in my experience, prevented the loss of valuable customers, as the withholding of it has to my knowledge resulted in losing them.

It is not possible to say what should be the rate of discount in any particular case without knowing the circumstances; but it is quite safe to say that a range from 2½ to 5 per cent. is as nearly right as possible. In large towns, where there are consumers to the extent of £1000 a year, the discount may be graded as follows: 5 per cent. on £1000 a year and upwards, 4 per cent. on £500 to £1000, and 3 per cent. on £100 to £400. This has been found to be satisfactory. Then an allowance on what may be called regular all-the-year-round consumers is just, and may be made with advantage, particularly where the gas is used for power or manufacturing purposes. As to cooking, it is difficult to assess; and a differential rate would be inconvenient. But the justice of the case might be met by reducing the usual rent for the cooker. In no case, however, does it appear to me that more than 5 per cent. should be allowed to any ordinary consumer.

The question of writing a paper for the Institution arose from a conversation on an idea that originated some years ago with Mr. Vernon Harcourt, F.R.S. It is that of the inclusion of the quality of the gas within the operation of the sliding scale. Suppose a fair initial price for 16-candle gas, and suppose the available coal supply will not yield gas of that power, necessitating the use of expensive enriching materials, which is a disadvantage both to the consumer and the company, then, instead of the hard and fast condition that 16-candle gas shall be supplied, let the sliding scale come in by providing that the initial price shall fall an agreed amount for each candle the gas supplied in any half year drops below the standard of 16. Such a plan would be fair to both parties. Gas of a lower quality could be made cheaper, and, that being so, justice would require a lowering of the initial price in due proportion; and the company, in order to avoid a reduction of dividend, would have to reduce the selling price. Such is the idea in general outlines; but it is hardly the subject for a paper.

I finish as I began. The early days of gas for the first forty years were times of competition. Then came the period of protected monopoly, when no effort was needed to obtain prosperity if it consisted in the paying of good dividends. Now prosperity can only be maintained or obtained by effort wisely directed and justly applied, which must oust the easy-going conservatism of the past. The development of gas in spite of such adverse conditions has been great hitherto; and we may expect that the new conditions, requiring the exercise of the highest business qualities, coupled with liberal treatment and just dealing towards the consumers, will have their usual and proper reward.

CARBURETTED WATER GAS.

By VIVIAN B. LEWES, F.I.C., F.C.S.

During the last five years, many attempts have been made to introduce carburetted water gas as a means of enrichment in English gas-works; and so much has been said and written as to the various processes, that any long description of them would be out of place.

So far, the Lowe improved plant at Beckton has been the only one sufficiently successful to attain to continuous working; and in attempting to enter into details of cost, we may at once set aside all other processes.

As to the economic efficiency of this plant, there are several sets of figures to choose from. At the 1891 meeting of the Institution, Mr. A. G. Glasgow, of the Lowe Company, read a paper in which he gave indirectly the necessary data.* He said, while discussing the use of Russian distillate oils: "Some of them—notably one known as Solar Distillate—quite equalled the American oils. The cost of this oil, I am told, is 3¼d. a gallon; making the total cost of the oil 11½d. per 1000 cubic feet of 24-candle gas." From this it is inferred that 3·54 gallons of the oil gave 1000 cubic feet of 24-candle power gas, or equal to 1356 candles per gallon. At the same meeting, Mr. Thomas Goulden, of Beckton, also read a paper on the subject,† in which he said: "An illuminating gas *has been made* of 29·5-candle power, at an expenditure of 4·5 gallons per 1000 cubic feet of gas;" this being equal to 1311 candles per gallon.

A year passed by, during which time the apparatus was in constant work; and at the 1892 meeting of the Institution, Mr. Goulden, in conjunction with Mr. A. M. Paddon, read an interesting paper on the "Technology of Water Gas"—their data being derived from the use of the same oil in the Beckton plant.‡ As the result of matured experience with its working, they gave 5·6 gallons of oil as the necessary quantity to yield 1000 cubic feet of 24·68-candle power gas, or an efficiency of 903 candles per gallon.

The oil used in all these experiments is a Russian distillate oil known as Solar Distillate, and having a specific gravity of ·860 and a flash-point of 130° Fahr. It is obtained by distillation from the residuum left after the light kerosenes and heavier lamp oils have been

* See JOURNAL, Vol. LVII., p. 952.
† *Ibid.*, Vol. LVII., p. 950. ‡ *Ibid.*, Vol. LIX., p. 908.

distilled from the crude oil. This residuum, known in Russia as "Astaki," was for many years a waste product, and was burnt away on the ground, in order to get rid of it. It was then introduced as a fuel, and is now very extensively used for that purpose; while during the past few years it has been subjected to still further distillation, and yields the Solar Distillate and also lubricating oils. Taken by the shipload—about 2000 to 2400 tons—it costs 3d. a gallon at the large London works, which can avail themselves of water carriage; but at the majority of inland works, 3½d. to 4d. will be the more usual cost. In calculating the price of carburetting water gas in the holder, it is of no use shutting our eyes to this most important factor.

Taking the plant at Beckton, the author calculates that the average cost of the 25-candle gas per 1000 cubic feet in the holder is as follows:—

	s.	d.
Oil, 5·75 gallons, at 3d. per gallon	1	5¼
Coke for generator and boiler, 60 lbs., at 12s. 6d. per ton	0	3¾
Labour	0	1½
Purification	0	0½
Repairs and charge on plant	0	1
Superintendence	0	0½
Water	0	0½
Total	2	0¾

For use as an enricher in a large works, where the output is sufficiently great to need from 1 to 2 millions per diem, it would compete with cannel at this figure; but it must be clearly borne in mind that it could not be made on a smaller scale at this price.

It will probably be remarked that nothing has been allowed for the tar made; but, as an answer to this, the author can only plead that, as far as he knows, the tar has up to now proved not only useless, but an unmitigated nuisance, as it contains often as much as 70 per cent. of water, which is difficult to get rid of, and renders it almost impossible to distil.

Several lessons have been learnt from the attempted introduction of carburetted water gas, the most valuable of which is that the time is ripe for the adoption by English gas managers of methods of production and enrichment which are able to comply with the requirements of both manufacturer and consumer; and attention being once drawn to this fact, it will not be long before vigorous attempts will be made to meet the demand. Already such well-known methods of enrichment as the Maxim-Clark are doing good business; and it is hoped that the author will be pardoned if he brings before you his own ideas as to how the lessons taught by carburetted water gas can best be utilized.

The importance of the labour question in this country has undoubtedly given carburetted water gas an opportunity which, if the results attained in practice even partly bore out the claims made for it, would go a long way towards securing its introduction, as the rapidity and ease of manufacture reduces to a minimum the labour employed. It is also evident that, for a new process to be entirely successful, a high rate of making and simplicity in handling must be attained. Another important consideration which must always exercise great influence over the chances of general adoption is that the initial cost of the plant must be as small as possible, and the construction so simple that the charge on plant and maintenance shall be reduced to a minimum. Here again the water-gas processes have an advantage.

A great drawback to the introduction of water gas, either by itself as a fuel or carburetted for illuminating purposes, has undoubtedly been the large percentage of carbon monoxide, which is not only itself the most deadly of gaseous poisons, but also, when present in large quantities, adds considerably to the vitiation of the atmosphere of the rooms in which it is burnt, by increasing the proportion of carbon dioxide formed as a product of combustion. Carburetted water gas contains on an average 30 per cent. of carbon monoxide; and in a small room, with a gas-jet delivering at the rate of 6 cubic feet an hour, it is perfectly possible, if by accident the jet is left on and not lighted, in a few hours to reach the limit of danger. With coal gas, with 3 to 6 per cent. only of the poisonous constituent, it would be practically impossible to do so, as diffusion through the walls and frames of windows and doors in our modern-built houses would prevent any large percentage of gas collecting; and the author is of opinion that, if the carbon monoxide can be reduced to from 15 to 18 per cent., there would be but little danger. In the States, the opposition to water gas on account of its percentage of carbon monoxide was very strong in the early days of its introduction; but it is a significant fact that it seems to have quite outgrown the opposition, although the researches of Professors Sedgwick and Nichols showed the danger with gas containing 30 p. ct. to be a very real one.*

To the gas manager, the excess of carbon monoxide is a drawback, because its presence in large quantities affects the illuminating value of the gas. Last year the author read a paper before The Gas Institute,† in which he pointed out that, in the generation of light from coal gas, only a comparatively small amount of the heat generated by the combustion is converted into light—a large excess of heat being necessary to complete the actions culminating in the separation of the carbon particles; and any alteration in the composition of illuminating gas which increases the thermal value of the flame, without destruction of the carbon particles, will increase its luminosity. This, he believes, is the cause of some diluents of coal gas being of greater value than others, and affecting less than others the amount of light emitted by the flame. For instance, the researches of Dr. Percy Frankland and the author's own work of recent date show conclusively that methane is the most valuable gas to use for diluting heavier hydrocarbons, while hydrogen is far preferable to carbon monoxide. This latter result has been questioned; but he thinks the experiments then brought forward conclusively prove the fact.

There is one thing, however, which water gas will do, and which it is almost impossible to succeed in without its aid—viz., it forms an admirable vehicle and diluent for oil vapours during their decomposition into permanent gases. All will no doubt admit that it will be necessary to turn to oil as the enricher of the future; and exhaustive experiments have shown that it is impossible to generate oil gas alone in sufficient quantity and at a rate of make high enough to supply large works, without increasing instead of diminishing the amount of necessary plant. If a sufficiently high temperature is employed to make gas rapidly, it suffers in quality from over-decomposition and deposition of carbon—a trouble which is to a great extent avoided in making carburetted water gas, by the flow of water gas rapidly sweeping the hydrocarbon gases as they are formed out of the superheater, and so saving them from destruction, partly by dilution, and partly by shortening the time they are in contact with the heated surfaces.

The author's researches upon the effect of heat upon such hydrocarbon gases as are most valuable in endowing combustible but non-luminous gases with luminosity, show that no greater mistake can be made than to allow such gases as ethylene to remain for long in contact with the sides of retorts, or superheating material of any kind, at a temperature of redness, as it results in the conversion of ethylene, with its high illuminating value, into methane, and a large number of solid and liquid hydrocarbons which find their way into the tar, among which benzol and naphthalene are conspicuous. The idea of decomposing the vapour of oil by long contact and increasing heat is undoubtedly wrong, and this has been recognized in making coal gas. The right method is to quickly decompose the oil vapour, and then, by a rapid rush of inert gas, to remove from the action of further heat the hydrocarbons resulting from the decomposition. If it is desired to convert the oil partly into gas and partly into such products as benzol, long heating and plenty of surface are required; but to get the largest proportion of illuminating gas and the minimum amount of residuals, rapid decomposition at a high temperature, and a rapid removal of the gas, are far preferable.

It seems, therefore, that the points which should be aimed at, in devising a process for making an illuminating gas other than coal gas for use in enrichment or *per se*, are:

(1) Rapidity of make and simplicity of working.
(2) Compactness and cheapness of plant.

* See JOURNAL, Vol. XLVII., pp. 487, 583, 682. † *Ibid.*, Vol. LIX., p. 1232.

‡ Since this was written, I have been carefully looking into Mr. Young's process at Peebles; and, in view of the results he obtains, it is evident that the plant would not be any larger than a gas plant. He certainly makes a very rich oil gas at the same rate, and with the same plant, as in making coal gas.—V.B.L.

(3) Reduction of the percentage of carbon monoxide.
(4 Decomposition of the oils, so as to obtain from them the maximum illuminating value and the smallest amount of tar.
(5) Making the gas of such quality and specific gravity that the present knowledge of rates of flow in mains, &c., shall still be available, and that no alterations in the method of consumption are necessary.

In approaching this problem, the author's first idea was to make hydrogen as nearly pure as possible, and then to enrich it either by the vapour of light hydrocarbons, as in the Maxim-Clark process, or by oil gas as made in the carburetted water gas processes. Efforts to make hydrogen cheaply were fairly successful; and it was found possible to make a gas containing 84 to 90 per cent. of hydrogen at a price very little, if any, dearer than water gas.

The method employed by the author to do this was to use an apparatus consisting of a vessel charged with iron turnings, and more or less completely surrounded with a fuel chamber. The temperature of the whole was raised to an intense heat by passing a blast of air through the fuel chamber. The incandescent producer gas thus formed was made to pass through the vessel containing the iron. When the iron had become sufficiently heated, the air-blast was stopped, and a jet of superheated steam introduced into the vessel containing the iron. The steam was thus decomposed by the iron; iron oxide being formed, and hydrogen liberated. When the evolution of hydrogen became slow, the steam-jet was stopped, and the air-blast re-started. The incandescent carbonic oxide of the producer gas reduces the iron oxide which had just been formed, and again brings the iron, which has been somewhat cooled during the previous operation, to the requisite temperature. The revivification of the iron being thus performed *in situ* during each alternate air-blast stage, the plant can be worked continuously, without recharging the vessel containing the iron; in fact, the iron only attains its maximum activity when it has been in use for a short time.

In carrying out this operation, the chief troubles to be overcome were that the reducing blast carried over a quantity of fine carbonaceous dust on to the iron, and also deposited a white powder consisting chiefly of silica, magnesia, and alumina, brought over in gaseous combination from the fuel. This, however, could be met by placing a couple of layers of coarse asbestos cloth above the iron, which could be removed and shaken free from dust after each day's work. A more serious trouble was that, if the temperature of the iron chamber became too high, the oxide of iron formed in making the hydrogen fused. But this trouble could be avoided by regulating the thickness of the wall between the iron chamber and the fuel, minimizing the period of blowing up, and altering the construction of the generator so as to heat the iron on one side only.

Having succeeded in making hydrogen of a reasonable degree of purity, it was soon found that it was by no means the perfect gas for ordinary purposes it had always been believed to be, for its high rate of diffusion caused an enormous loss in storeage and distribution, while the comparatively small proportion of air necessary to form an explosive mixture with it introduced a certain element of danger; and although, on carburetting it, these troubles were reduced, yet the author soon came to the conclusion that any percentage of hydrogen much over 50 per cent. was inadvisable, as it interfered with the rate of flow of the gas and the size of the flame.

The next attempt was to make a gas which should as nearly as possible approach coal gas in composition; and in the form of apparatus experimented with of late, a uniform mixture of oil gas, water gas, and hydrogen has been made which will, at any rate, more nearly approach to the requirements laid down than any other process with which the author is acquainted.

The apparatus consists of one generator containing three compartments, the central one filled with coke, and the two side ones with iron. The coke is raised to incandescence by air-blasts, which enter at the bottom of the fuel, while the products of combustion, consisting of carbon monoxide and nitrogen, are made for the first four or five minutes of each "blow" to pass down through the iron chambers, so as to reduce oxides of iron back to the metallic form, as in the well-known working of the blast-furnace. When the necessary temperature has been reached, the blast is shut off, and superheated steam is admitted to the bottom of the iron chambers. In passing over the red-hot iron, the steam is decomposed, yielding hydrogen gas, and forming oxide of iron. At the same time that this is taking place, crude oils are injected by superheated steam into the centre of the fuel. The incandescent carbon of the fuel decomposes the steam into a mixture of carbon monoxide and hydrogen, which mixture surrounds and protects the oil during decomposition (or "cracking"), and prevents it from being burnt up, but permits of its being, by the high temperature to which it is subjected, properly decomposed into permanent hydrocarbon gases of high illuminating value. A second jet of steam is admitted below the oil injectors, so that if the oil is being over-cracked, or if it shows a tendency to run down in the fuel, an uprush of water gas can be produced in the generator, and the oil gas swept out more rapidly. The hydrogen, oil gas, and water gas made in this way mingle in the top of the generator, and pass away to cooling-coils and purifiers. When the temperature in the generator has fallen below the point necessary for the rapid production of gas, and when the percentage of carbon dioxide begins to rise, the valves leading to the gas-mains are cut off, and the air-blast is again turned on; raising the fuel to incandescence, and reducing the iron oxide back to metallic iron in readiness for another make of illuminating gas.

This process has been experimented with and reported upon by Dr. Leonard Thorne; and in his experiments he finds that 3·75 gallons of oil were used in the production of each 1000 cubic feet of 20·7-candle gas. On comparing these figures with those given by Messrs. Paddon and Goulden for the best results obtainable for the Lowe process, they show a saving of 22·2 per cent. in the oil used; and since these experiments were made, further figures have been obtained which show an improvement of more than 40 per cent. Moreover, it must be remembered that the figures for the Lowe process were obtained from a plant working continuously and on a very large scale; while those above mentioned were got from a small plant only worked occasionally, and under conditions which rendered it impossible to get even temperatures. On analyzing the purified gas, Dr. Thorne obtained the following results, which, for the sake of comparison, are contrasted with an analysis of purified Lowe gas:—

	Lowe Gas.	Lewes Gas.
Hydrogen	22·6	40·77
Saturated hydrocarbons, methane, &c.	31·9	29·20
Unsaturated carbons, ethylene, &c.	13·4	41·21
Carbon monoxide	29·2	15·15
Oxygen	0·6	0·13
Nitrogen	2·3	0·54
	100·0	100·00

It will be noticed that the most marked feature is the large increase in the hydrogen present, and the reduction of the carbon monoxide to nearly half—a result which will undoubtedly give this gas many advantages.

The gas is made with the same rapidity as the ordinary carburetted water gas; while, the external superheating chambers being done away with, great compactness is attained. A generator to produce 250,000 cubic feet of gas per diem only occupies a space 18 feet by 7 feet and 10 feet high; the initial cost being far below that of any other plant. A coal-gas plant to generate 250,000 cubic feet per day may, for comparison, be taken as costing £100 per retort, which will produce 10,000 cubic feet of gas in 24 hours; so that a bench of 25 retorts, costing £2500, would be needed for the coal gas. The Lowe plant to make the same volume of gas per diem would probably cost about £900; while the generator above described would only cost about £450.

As regards the specific gravity of the gas, it can be made almost identical with that of coal gas. The price of a gas made by this process will be considerably lower than a water gas made by the Lowe process; while it has the great advantage of a reduced proportion of carbon monoxide. In places where the gas companies have a 14-candle standard, and are able, therefore, to make gas from a fair coal without going to the expense of enrichment, the saving in expense gained from such a process would only be small; but there are several points which would make its adoption of great importance to the gas engineer.

In the first place, with the labour market in its present

condition it would enable the manager to maintain a permanent staff equal to his summer consumption, while during the winter months the auxiliary plant would be worked, and only three or four additional men would be needed to give the extra production of gas. In many places, where the sale of coke is small, it would prevent the price falling below a remunerative point from overstocking; and the plant would be ready in case of any such emergency as sudden fog or labour troubles.

Where, however, a 16 to 20 candle gas has to be supplied, the process would become far more valuable, as it would enable the engineer to make a certain proportion of his output of a 22 or 24 candle gas, and to use it as an enricher for the remaining coal gas, which could be made without employing cannel. Used in this way also, it would be a great relief to those works which are under the necessity of keeping the sulphur compounds below 20 grains, as this gas contains hardly any sulphur compounds other than sulphuretted hydrogen, and an admixture of it with ordinary coal gas would bring these compounds well within the limit without extra purification.

CARBURETTED WATER-GAS APPARATUS.

By A. G. Glasgow.

The manufacture of carburetted water gas, dating commercially from 1875, has grown in these eighteen years to an extent that it embraces two-thirds of all the gas manufactured in North America, while a sufficient quantity has for some time been daily supplied to the inhabitants of London. So phenomenal a development naturally suggests that the manufacturing apparatus soon reached a degree of efficiency leaving small room for improvement. Such, however, was by no means the case; and it is the purpose of this paper to point out, in very general terms, some of the features of the apparatus that have quite recently felt the hand of progress.

A critical observer of the operation of water-gas apparatus as constructed in the past cannot fail to notice (1) the waste energy in the blast products escaping to the atmosphere; and (2) the quantity of cinder taken from the generators during the process of cleaning the fires. While more minute examination discovers (3) a large, but apparently unavoidable, excess of steam admitted to the generators over that actually converted into gas; and (4) the need for improvement in the treatment of the enriching oil, evidenced by the uneven heating of the carburetters, the carbonization and crumbling of the checker bricks first receiving the oil, and the large percentage of condensable tarry vapours in the gas when crude oils or heavy distillates are used. A change from anthracite coal to the use of gas coke in the generators further develops (5) a marked reduction in the output of the apparatus, aggravated by a considerable increase in the carbon dioxide present in the gas.

The foregoing being generally recognized as the distinctive features unfavourable to economy in water-gas manufacture, recent improvement has naturally followed these paths. Any systematic scheme of improvement requires a perfect knowledge of present conditions. The analytical study, necessary to this end, of the conditions of water-gas manufacture has, during the past several years, been searching and thorough.

In 1890 complete determinations were made of the thermal losses in the conversion of the staple supplies into carburetted water gas; and as this work furnished a scientific basis for economic progress, and displays concisely the conditions of working generally existing to-day, an epitome of the writer's paper read before the American Gaslight Association in that year is given in the following table. The results were from a single setting, newly constructed, making continuously between 400,000 and 500,000 feet of gas daily, under the most careful manipulation.

Considering the unaccounted-for energy as carried away in the excess steam, there was a necessary waste of 10,091 ÷ 23,500, or 43 per cent. of the total combustible; the absolute efficiency of the apparatus, considered as a heat-engine, being 57 per cent. The table shows that, under the most advantageous conditions, 5·115 lbs. of combustible (equivalent, say, to 5½ lbs. of coke) were lost in the blast gases. It must be borne in mind that this represents merely the loss due to the sensible heat of these products of combustion. With (as is usually the case) carbon monoxide escaping to the atmosphere the waste at this point may be greatly increased; the total, 33½ lbs. of fuel shown above easily growing to 45 or 50 lbs. Extravagant results in fuel can generally be traced to this cause.

Distribution of Energy per 1000 *Cubic Feet.*

	Pounds.	Heat-Units.
Total generator fuel	33·4	—
Ash and unconsumed coal recovered	9·9	—
A.—Total combustible (carbon)	23·5	340,750
B.—Energy of the carbon monoxide produced	6·280	91,043
C.—Energy absorbed in the decomposition of the steam	6·243	90,533
D.—Difference between the sensible heat of the escaping illuminating gas and the entering oil	1·852	26,864
E.—Heat carried off by the escaping blast products	5·115	74,152
F.—Heat lost by radiation from the shells	0·858	12,454
G.—Heat carried away from the shells by "convection" (air currents)	1·082	15,696
H.—Heat *rendered latent* in the gasification of the oil	0·886	12,841
I.—Sensible heat in the ash and unconsumed coal recovered	0·256	3,712
Total energy accounted for	22·572	327,295
Unaccounted for (4 per cent.)	0·928	13,455

The energy accounted for may be divided into—

Energy utilized . . . . . 13·409 lbs.
Energy wasted . . . . . 9·163 „

It is essential, therefore, that the apparatus be so designed that a perfect working balance is maintained between the demand for energy in the fixing chambers, and that supplied by the generator when on blast, in spite of wide variations in the quality of fuel. This equilibrium involves, broadly speaking, a correct relation between the area and depth of the generator fire and the blast pressures throughout the apparatus; and gradual development upon these lines has finally resulted in overcoming completely the waste due to the presence of carbon monoxide in the blast products. The total waste in the stack gases is, therefore, limited to the 5½ lbs. of coke represented by their sensible heat. While it does not seem a difficult problem to apply this waste energy to useful effect, none of the numerous devices hitherto tried have yet been commercially successful.

Referring again to the table, it will be seen that, of the total 33½ lbs. of fuel, 10 lbs. are taken from the fire during cleanings, representing about 2 lbs. of ash and 8 lbs. of fuel. This large accumulation is due to the fact that the steam, being always admitted to the bottom of the fire, cools the lower stratum below the point of ignition, so that the subsequent blast, instead of rekindling, chills it almost to the temperature of the atmosphere. When steam is again admitted, a portion of it will condense in this cold cinder, and the formation of the condensing stratum, having once begun, increases so rapidly that it is usually found desirable to clean the fire about every four hours—removing a large quantity of half-burned fuel.

The comprehensive correction of this trouble requires an even distribution throughout the fuel-bed of that temperature at which the steam is, in the time fixed by the capacity of the apparatus, most economically converted into gas. This is accomplished with almost theoretical perfection (disregarding the cooling of the top of the fire caused by charging) by periodically reversing the current of steam in the generator; for which purpose means have been devised that materially lessen, instead of increase, the labour and responsibility of gas making. This practically eliminates the second and third of the unfavourable features mentioned at the outset.

By way of illustration, it may be interesting to know that important works in the vicinity of New York have, by revising the apparatus upon the lines already described, reduced the consumption of generator fuel per 1000 feet during the past twelve months, to two-thirds of the quantity used during the previous year. The same changes are being made at all other works under that management.

The fourth unfavourable feature upon the list concerns the vital question of oil economy. Up to within a comparatively few years, the enriching oil was fed into the generator. This answered fairly well for extremely volatile distillates, such as high-grade naphtha; but when the use of cheap crude oils and heavy distillates was attempted, the necessity for change became evident. It was seen that the work of the apparatus was unfairly distributed. The generator was greatly overtaxed, resulting in diminished yield and increased fuel and carbon dioxide; while the service performed by the fixing chamber was not sufficient

to absorb the carbon monoxide, contained in the generator blast products. As a natural consequence, some of the work then performed in the generator has been transferred to the fixing chambers through the development of the present carburetter. This carburetter was originally introduced more to relieve the generator of work other than the decomposition of the steam, than to effect direct saving in oil; indeed, it was predicted, by those seeing some mysterious advantage in the exposure of the oil to the nascent hydrogen in the generator, that decreased oil efficiency would follow.

The actual results from the change so far exceeded the expectations of the most sanguine, that it may be well to dwell a moment upon the circumstances. Owing to fresh fuel—usually cold—being fed periodically into the generator, the top foot or two of the fuel-bed is subject to wide variations in temperature, however uniformly the heat may be distributed in the active portion of the fire. For instance, shortly before charging, the entire fuel-bed is in a condition to decompose steam; while immediately after charging, the top couple of feet are quite cold. It is clear, then, that oil introduced at the generator top is at the one time exposed to a heat that often proves destructive, while at another it saturates the cold fuel like a sponge, to be driven off during the succeeding blast. In the carburetter, however, with the temperature regulated at will, regardless of generator variations, the oil can be volatilized under heat conditions of maximum economy in the beneficial atmosphere of the hot water gas.

In spite of the improvement due to the introduction of the carburetter, the fourth of the unfavourable features mentioned still prevailed. The sources of this trouble are threefold: First, the imperfect distribution of the entering oil over the cross section of the carburetter; secondly, the absorption of the oil, owing to the porosity of the checker bricks, and the consequent carbonization and disintegration of the latter; and, thirdly, the absence of an efficient and durable oil pre-heater. Added to these is the possibility, where very heavy non-volatile oils are used, of a portion of the oil reaching the bottom of the carburetter in a liquid condition, and accumulating as an oily tar, to be burnt away in the succeeding blast.

The first and second of these difficulties have been largely overcome by Mr. C. R. Collins, of Philadelphia, whose oil-spraying device and method of filling the carburetter are highly valuable improvements. The third difficulty—largely a matter of detail—was readily removed when it received the proper attention; while a considerable addition to the height of the carburetter now ensures the entire vaporization of the oil, and its complete passage to the superheater for conversion into permanent gas.

The fifth, and last, unfavourable feature on the list invites special provision in the design of the apparatus for the more advantageous use of gas coke. Anthracite coal, being nearly twice as heavy as coke, and storing therefore, in a given space, nearly twice the capacity for steam decomposition, can, it is evident, be worked advantageously under conditions most unsuited to the use of coke. This circumstance being once intelligently recognized, the evolution of an apparatus using indiscriminately coal or coke to equal advantage has not been difficult. The minor losses, due, as shown in the table, to radiation and "convection," have been recently halved by increasing the thickness of linings and non-conducting fillings.

The writer has purposely avoided tedious description of the progressive steps in the development of water-gas apparatus; but, in general, it may be said that, while trial and error afforded the first bases for attempted improvement, the principles underlying the operation of the apparatus have latterly become so well understood and experimental data so complete, that its latest revision has been made with a scientific regard for cause and effect that places the apparatus upon a par with any modern type of heat-engine.

NOTES ON THE APPLICATION OF OXYGEN TO LIME PURIFICATION AT SHREWSBURY.

By W. Belton.

Almost everything possible appears to have been written and said upon the use of oxygen in gas purification, and upon the "air process," which is so closely allied with it that the consideration of the principles and properties of the one must apply with greater or less force to the other; and the author, having already furnished all the information at his disposal to many inquirers, doubted whether any further contribution by him would prove of sufficient interest to warrant its being brought before the members of this Institution. It was, however, desired that he should prepare a paper upon the subject for this meeting; and his experiences have therefore been noted down.

Shrewsbury is a residential town, and the gas-works occupy the site (with some additions) upon which they were erected in 1820—at that time outside the town. The works are now, however, surrounded by house property. Their area is extremely limited; and the site cannot be extended. There is only coal storeage for two weeks' supply in mid-winter; and, indeed, a few years ago, it was impossible to find room for oxide revivification by the then ordinary method. Partly on this account, and partly because of the difficulty of satisfying the Corporation in the matter of purity and illuminating power, the use of oxide was altogether abandoned; lime being comparatively cheap, and more effective under the circumstances. The Shrewsbury Gas Act fixes a standard illuminating power of 15 candles, and a limit of 20 grains of sulphur; but the Corporation require much more than this, and do not fail to complain if, by any chance, the illuminating power is not more than one candle above the standard, or the sulphur compounds more than one-half the limit, according to their tests. The latter, it may be remarked in passing, generally differ from those made by the Company's officers.

It is needless to recount the difficulties of sulphur purification—they are well known to all of you; nor the necessity, in a situation such as has been described, of preventing all possible nuisance therefrom. In residential towns, where odours arising from gas-works have to go forth undiluted by those from other factories, noses are so very sensitive that it is difficult even to open a purifier without causing complaints and threats to pour in; and, on one occasion, complaints were made of the nuisance arising from a set of purifiers that had not only never been used, but the erection of which was not completed. No other purifiers were or had been open about that time; and no nuisance at all existed. The discomfiture of those who made the complaints, and who eagerly accepted a prompt invitation to enter the works and find for themselves whence the nuisance proceeded, was most complete; and its after-effects were very beneficial.

It was these and other considerations, and perhaps some ambition not to lag behind on this or any other question, that induced the Directors to desire an investigation as to what improvements could be effected in purification; not altogether on the score of economy, for lime purification was then being effected for 0·71d. per 1000 cubic feet of gas sold, but because they desired to turn out the gas as pure as could reasonably be expected, and to put themselves in a position to say they had done all they possibly could, and had adopted and practised the best-known method of securing purity without causing a nuisance. Several schemes were considered—*i.e.*, separate bisulphide vessels, the Claus system, the oxygen process, and its near relative, the air process. It is not proposed to enter into the merits or demerits of all these, but broadly to give the reasons for selecting the oxygen process.

The use of separate bisulphide vessels was objectionable, because of the nuisance caused when opened, though this might be seldom, and would also involve further overcrowding of the works, with loss of part of the already insufficient coal storeage, besides incurring considerable cost for alterations to buildings, connections, &c., in addition to the outlay for the boxes themselves. It was considered that the Claus system had not yet arrived at such a state of promise as would justify the expenditure necessary for its introduction. There remained the oxygen process and the air process, both of which required fuller consideration.

It was promised for the oxygen process that the purification would be effected in fewer and smaller vessels; that the lime would do more work, and leave the purifiers quite deodorized; and that there would be a large gain in illuminating power. Investigation at Ramsgate and in London, and some careful small-scale experiments at Shrewsbury, tended to confirm these promises, though not to the extent claimed by the advocates of the system; the main difference being that these experiments and investigations showed a gain of 1 to 1½ candles illuminating

power, as against a much larger gain claimed. This is attributed chiefly to the fact that the carbon dioxide had long been completely removed at Shrewsbury. Inquiries elicited that the air process would also reduce the necessary purifying area, increase the efficiency of the lime, and also deodorize it; but no gain in illuminating power was promised. It was only stated that there would be no loss if the percentage used was not too great, but that a gain might be obtained, and a larger percentage used, if the air was first carburetted.

The consideration of these two processes, in the light of the theory that 0·1 per cent. of oxygen is necessary for the complete oxidation of every 100 grains of sulphur per 100 feet of gas, showed that while, with a low sulphur percentage in the foul gas, sufficient air might be used to provide the required quantity of oxygen without loss of illuminating power, if coals were used which gave a high percentage of sulphur, the quantity necessary would very probably deteriorate the gas considerably unless carburetted, and that it was doubtful how far such carburetting would be efficient or permanent. The proportion of oxygen existing in air being about 21 parts in 100, there are 79 parts of inert nitrogen which must go with it, which, if it did not actually show any deterioration of the gas at the outlet of the purifiers, must inevitably counteract any improvement effected by the oxygen, as it would be passed on (still inert) whenever the oxygen was taking effect on the sulphur.

Thus, with gas containing 600 grains of sulphuretted hydrogen, 0·6 per cent. of oxygen would be theoretically necessary, which would be furnished by 2·86 per cent. of air, of which 2·26 per cent. is inert nitrogen. But with gas containing 1200 grains of sulphuretted hydrogen, double the quantity would theoretically be required; and it was understood that the safe limit was much lower. At Shrewsbury, coal is drawn from various districts—sometimes from two or three at once; and the percentage of sulphur in the gas is found to vary from 500 to 1200 grains. It therefore appeared that, for a thoroughly satisfactory use of oxygen, the oxygen process itself must be adopted, wherein its influence would be untrammelled by the presence of inert nitrogen, and that any possible advantage to our station meter record by the use of air, carburetted or otherwise, must be abandoned for the more solid advantage of applying a scientific process in a scientific way, so as to obtain the best results without the probability of losing the greater part of them, as soon as gained, through dilution of the agent employed.

Of course, the financial aspect of these questions was not neglected; and here it was considered that, on all accounts, there was really very little to choose. If the air process cost little or nothing, it did not promise any material saving; and the oxygen process, though promising more, would also be more expensive. It was at that time difficult to estimate the cost or gain in either case. But careful consideration showed that the balance, if any, ought to be in favour of the oxygen process; and it was therefore decided to adopt it.

The plant was supplied by the Brin Oxygen Company, and erected by the Gas Company, who also provided a gasholder and distributory apparatus. When complete, the plant consisted of the following appliances: A double-acting vertical air-pump, steam driven, and capable of maintaining a vacuum of 28 inches of mercury; automatic machinery for reversing the valves belonging to plant, geared to the pump driving-shaft; a lime purifier; a caustic soda purifier; a set of twelve straight steel retorts, 6 inches in diameter, set vertically in two chambers on either side of a generator furnace with superposed combustion chamber; anhydrous oxide of barium for charging the retorts; covers and weldless steel branch-pipes to close and connect the retorts; a hand change-valve, for reversing the direction of the current through the retorts; connections, partly copper, partly iron (including a cast-iron empty catch-box between the purifiers and the valves attached to the reversing gear; a gasholder, 16 feet in diameter and 15 feet deep, having a capacity of 3000 cubic feet, provided for water-weighing on the top, complete in cast-iron tank; an automatic distributing apparatus as patented by Mr. C. B. Newton, actuated by electricity from the station meter; and valves and connections to the gasholder, distributory plant, and to the foul-gas main leading to the purifiers.

It was stated that it would be necessary to remove and break up the barium about every two months. Certain alterations have, however, been made to the plant since its erection. The combustion chamber of the furnace has been divided by a vertical wall in the centre; thus enabling one side of the setting to be worked without the other, and so facilitating repairs or changes of barium being made without stopping the oxygen supply. A copper catch-box, filled with washed hair, has been fixed on the main connections leading to the retorts. Cast-iron taper retorts have been substituted for the parallel steel ones. The hand-change valve has been discarded for an automatic valve actuated by the pressure in the retort connections, and changing the direction of the current every time exhaust gives way to pressure.

The general result of these changes has been to render the automatic character of the plant much more complete, and to lengthen the life of the barium, so that it has been workable for twelve months without any necessity for change, and without very material deterioration.

It is believed that this plant and the present Ramsgate plant were ordered and erected simultaneously, and were the first of their kind—thus furnishing experience rather than being the result of it; and the estimate of the yield of oxygen from the barium employed proved too sanguine. This may have been due not so much to the absorptive capacity of the barium being over-estimated, as to the difficulty of obtaining a sufficiently high vacuum—28 inches being insufficient to thoroughly exhaust the oxygen from the barium in the space of time allotted. It is known that much better results are obtained with 29 inches of vacuum; and in this direction it is believed further improvements are being made. The Brin Oxygen Company are now providing for this purpose pumps having improved slide-valve cylinders, in which a small passage is made in the valve in addition to the ordinary passages. This small passage is so arranged that, when the piston is at the end of its stroke, with the holder pressure on one side and the full vacuum of the plant on the other, communication on either side of the piston is established, and the small clearance spaces under the holder pressure are instantly shifted into the larger space under vacuum, with the result that a vacuum is established throughout the cylinder and passages a little less than the original vacuum at the back of the piston, but amounting to about 27 inches of mercury. When the piston returns on its stroke, instead of having to reduce the pressure in all the clearance spaces first (which means a travel of nearly half the entire stroke), it commences at once at a high vacuum, does useful work throughout the stroke, and creates a higher vacuum than could otherwise be obtained—probably within a quarter of an inch of perfect vacuum—which must give an enormous advantage in this process, by increasing the yield of oxygen per pound of barium.

Another improvement may be made by arranging the setting so as to more completely protect the retorts from the effects of the furnace gases; thus prolonging their lives. The retorts may in this way be made to last for three or even four years; and it is intended to attempt this at Shrewsbury, in the hope of securing some such result. The present retorts require changing after two years' regular work.

Turning to the attention required to work the plant, it will be found that it is comparatively trifling, and consists of firing and cleaning the retort-furnace daily; changing the barium in the retorts (about four men, six days each, once a year; oiling and cleaning the pump and changing gear daily; lifting and oiling the valves of the changing gear (about two hours weekly); changing the purifiers when exhausted (three men, two hours each, about every three weeks); cleaning the automatic change-valve (about two hours once in two months); and recharging the battery for the distributory plant once a year. Besides these, the works fitter, in the course of his daily supervision, will sometimes find it necessary to make some adjustment, or whatever else may be required to keep the plant perfectly tight.

Of these items, only the furnace attention is definitely paid for; and it is so little that it is undertaken by a stoker on each twelve-hour shift, in addition to his usual work, for an acknowledgment of 1s. 9d. per week. All the other work is performed, in the ordinary course of duty, by men already employed, without extra pay. Although satisfactory in itself, this renders it somewhat difficult to arrive at the exact cost of oxygen per 1000 feet.

With regard to the application of the oxygen and the results obtained, it has been before mentioned that the theory was propounded that 0·1 per cent. of oxygen was required for the complete oxidation of 100 grains of sulphuretted hydrogen in 100 cubic feet of foul gas. It was also stated that an excess of about 0·2 per cent. of oxygen would effect improvement in the illuminating power; and as at that time the sulphuretted hydrogen present in the gas was 600 grains, a commencement was made by using 0·8 per cent. of oxygen. Previously two sets of purifiers were in action. Now only one set of four in sequence is worked—two being quite fouled, and one partially so; and oxygen was first introduced under these conditions. It was found, however, that no effect of any sort was observable for some little time; and it was not until all the purifiers which had been fouled before the introduction of the oxygen had been changed, that the full benefit of it began to be apparent.

Some time after this, the effect was tried of introducing oxygen into a set of purifiers newly charged, and therefore all clean; reducing the quantity so as to allow of the formation of some calcium sulphide, after which it was used in the same proportion—viz., 0·8 per cent. In both cases good results were obtained as soon as the oxygen had time to take effect, which was much quicker in the latter case; but no material increase of illuminating power resulted until considerable heat was set up in the purifiers, which, where lime only is used, requires some time. These purifiers have an area of 480 square feet each, and are charged with five layers of lime—giving a depth of 2 ft. 4 in. in each purifier; experience teaching that lime purification is more effective with thin layers than with heavy masses. For a while afterwards, less than 7 grains of total sulphur were found in the purified gas; and it also appeared that in summer the 11 or 12 per cent. of English cannel that had previously been used could be entirely dispensed with, and the supply of gas maintained at about 17 candles. But after a time the carbon bisulphide present in the purified gas began to increase—at first slowly, then rapidly; and an investigation showed that the carbon dioxide had overtaken the sulphuretted hydrogen, leaving no calcium sulphide to assist in the removal of the carbon bisulphide.

By means of long-continued experiments, it was proved that this must inevitably occur at varying, though considerable, intervals, if an excess of oxygen was regularly passed through the purifiers; and that it was brought about sooner in summer with a slow flow of gas than in winter with a more rapid flow, no doubt because the longer contact favoured more complete oxidation at an earlier stage of purification. It was also found that the greater deposit of sulphur and longer use of the lime did not affect its affinity for carbon dioxide, but that the impurities were practically removed side by side, with the exception of carbon bisulphide, which could not be sufficiently reduced without the aid of calcium sulphide. A further fact was that the full benefit to the illuminating power could be obtained without the excess of oxygen, and that any excess beyond 0·2 per cent. did not produce any further improvement (though various proportions were tried) until enough was used to affect the illuminating power adversely; showing that the gain in luminosity is not due entirely to the heat set up in the purifiers, or, on the other hand, to the excess of oxygen only. Probably the heat liberates, or prevents deposition of, hydrocarbon compounds, for which the excess of oxygen acts as a permanent carrier.

Thus was established a very delicate margin in which to work between gain in luminosity on the one hand, and a low rate of sulphur on the other. Further extended experiments were, therefore, made to ascertain whether oxygen added to the purified gas would increase the illuminating power, and if the use of less oxygen through the purifiers would ensure steady results as to purity. These experiments (dealing with the whole make of gas) conclusively proved that the illuminating power could not be improved in that way; for no increase resulted even after adding 0·21 per cent. of oxygen, but it was found that, with the lesser addition of oxygen to the purifiers, the sulphur compounds were reduced lower than before, and that they could be maintained steadily at a low rate without fear of carbon dioxide again appearing at the purifier outlet. These experiments also showed that this result could not be depended upon continuously with the theoretical quantity of 0·1 per cent., but that it was reliable if 0·09 per cent. was used; and therefore this quantity has been adopted as the standard. Illuminating power is still gained, though not to the same extent as when 0·2 per cent. excess was used; but the satisfaction of having constantly certain results is secured, and every other advantage except the full increase of luminosity, the difference in which is not, in the opinion of the author, sufficient to compensate for the lack of certainty under the other conditions.

Experiences have proved that, with this process, one set of four purifiers is ample to carry out the purification, and also that, as the effect seems to be more marked when the flow of gas is not at its slowest, as in summer, purifiers somewhat smaller than those of ordinary theoretical dimensions are better than larger ones. It is also certain that a slightly higher percentage of oxygen may be used with a more rapid flow of gas; so that probably smaller purifiers would promote a larger gain in luminosity. Gas purified by lime with oxygen, as applied at Shrewsbury, burns with a very white flame, having a brilliancy which it did not possess before oxygen was used.

Preferably, the oxygen is introduced at the inlet of the purifiers; for, although it is easier to let it be drawn through the exhauster, it must then pass through the scrubbers. Then there arises another element to consider—viz., absorption of oxygen in the scrubbers. The rate of this would be variable; rendering it impossible to deliver an accurate quantity into the purifiers. Experiments have been made at various times to ascertain this; but though it was always found that considerable absorption had taken place, the amount of it was never the same, and ranged from 13 to 20 per cent. of the oxygen passing in the different tests. This waste is avoided by its introduction after the scrubbers.

It is absolutely necessary for the successful application of the oxygen that the quantity used should be regularly and accurately proportioned to the sulphuretted hydrogen contained in the foul gas. With Mr. Newton's automatic delivery regulator, as used at Shrewsbury, any alteration of percentage can be effected in a few seconds whenever desired. If accurate proportion be neglected, instead of satisfactory results being obtained, there will be nothing but vexation and dissatisfaction. The author has heard of oxygen being sent into the purifiers without any attempt at measurement or regulation; and he was not surprised that those so using it had little or nothing to say in its favour. How could they have? Fancy a chemical process, depending upon accurate proportion (as all such processes must do), with the very first principle ignored. Experiences at Shrewsbury have shown that without accuracy the process can at best be only partially successful, and may produce trouble and annoyance, but that with accuracy its results are satisfactory—almost automatic; and there is the comfort of knowing that the quality of the gas can always be depended upon, which is not to be despised.

Exactly when and where in the purifiers the oxygen is most effective, is a point difficult of determination; but it has always been observed that the greatest heat is apparently near the end of the calcium sulphide, just before the clean lime. There can be no doubt that the gain in luminosity is derived through the effect of heat in the purifiers, and that the action of the oxygen upon the sulphur is also most intense when most heat is set up; but it is very probable that this action commences immediately the oxygen enters the purifiers, and is continued in a varying ratio to this point—some sulphuretted hydrogen being still left to form calcium sulphide farther on.

On changing an exhausted purifier, the top layer is found rather wet; and although all the rest of the purifier may be inodorous, this layer is never entirely so, and retains the well-known dark green colour. The lower layers are usually dry and powdery, and are greyish or greenish yellow; and in the bottom of the purifier will be found a good deal of water. Part of the moisture in the top tier may arise through evaporation from the lutes; but the bulk, and most of the water in the bottom, will be due mainly to the moisture expelled from the calcium hydrate, or will have been formed in the reactions. Some of this moisture condenses on the under side of the cover, whence it saturates the top layer. A reduction of back pressure from these purifiers as soon as all were under the influence of the oxygen was noted; and, what is a great advantage, it was found that the back pressure did not increase as the

purifiers became fouler, although they were in use for a longer period than formerly.

In summer time it has been unnecessary to use any cannel at all in order to supply 17-candle gas. Very little was required afterwards until the thermometer fell below 40° Fahr.; while during the severe frosts it was found necessary to use cannel almost as largely as formerly—no doubt because this process could not prevent the usual condensation of hydrocarbons in the gasholders and distributing mains. During the last few months, North Staffordshire unscreened coal, notorious for its sulphury nature, has been used, containing an average of more than 1200 grains of sulphuretted hydrogen in the foul gas; and, though it has been necessary to use rather more cannel to keep up the illuminating power to 17 candles, and there was not a sufficiency of oxygen all the time, the total sulphur in the purified gas has averaged, by the Referees' test, only 7·15 grains—a result well worth achievement.

Comparing two full years' working of the oxygen process, during both of which there were prolonged and exceptionally severe winters, with a previous year having a mild winter and without oxygen, the following results were obtained:—

Without Oxygen.

Lime used	60¼ lbs.	per ton of coal.
Labour	1·80d.	
Cannel used	228½ lbs.	

With Oxygen.

Lime used	47¾ lbs.	per ton of coal.
Labour	1·35d.	
Cannel used	152½ lbs.	

If the two winters during the oxygen working had been mild, as was the previous one, the comparison would have been much more favourable for the oxygen process. The coals employed since the process was adopted have been inferior to those used formerly; the cannel being common English, giving 21 to 22 candle gas at the most. It must not be forgotten, too, that the use of oxygen has obviated the nuisance formerly arising from the foul lime.

As regards the expense of plant and of working, the total cost of the present plant, ready for work, was £1200. The cast-iron retorts will, it is believed, now last for three or even four years; and they may be renewed for about £5 10s. each. About 5 cwt. of barium, costing £75 per ton, is required annually to make up loss and waste. The wear and tear of the remainder of the plant is very slight. The fuel required averages 9 cwt. of coke per 24 hours. The lime placed caustic in the purifier is slaked; but it is so little affected by carbon dioxide, that it is returned to the lime-house, and used in the purifiers. The soda liquor is used in the steam-boilers in place of the composition formerly used, which it entirely replaces; thus costing nothing extra, while it is efficient, and harmless to the boilers.

So far the average cost of producing the year's supply, including wear and tear and all actual working expenses, but excluding interest on capital and royalty, has been 3s. 6d. per 1000 cubic feet of oxygen—the quantity being about a million cubic feet per annum; and the royalty adds 1s. per 1000 feet upon our small production. These figures should, however, be reduced with larger plants, as their first cost is proportionately less; and some advantage may be gained in their working, and by commutation of the royalty.

It remains to add that the entire cost of purification for two years with oxygen, including every expense connected with the process, and taking credit for the saving in cannel, was 0·70d. per 1000 cubic feet of gas sold, against 0·71d., which was the average cost for the previous ten years without oxygen. But, in considering this comparison, it must be remembered that during these two years inferior coal has been used, for which nothing is estimated; there has been freedom from nuisance; and constant and satisfactory purity has been obtained, although there has not always been a sufficiency of oxygen. The oxygen process, no doubt, suffers also in comparison, through having been applied during two exceptionally severe winters, as before stated.

Death of Mr. John Mews.—We regret to record the death, on the 7th inst., at his town residence in Westbourne Terrace, of Mr. John Mews, Deputy-Chairman of the South Metropolitan Gas Company. Mr. Mews had held this position for eight years; but he had been a Director of the Company and of the Phœnix Gas Company before the amalgamation for a period of abo[ut] twenty-three years. He was a gentleman of a retiring disposition; but in all matters of business he displayed sound judgment. His illness was very short. He attended the Board meeting of the Company on the 3rd inst., and appeared to be quite well. On his way to town on the following morning, however, he was seized with illness; but he managed to get back to his residence. He was better during Friday and Saturday; but in the evening of the latter day he had a relapse, and died early on Sunday morning, in his 72nd year. In addition to the vacancy in the directorate of the South Metropolitan Gas Company, Mr. Mews's death causes others on the Boards of the Union Fire Office and the Surrey Commercial Dock Company.

Magnesia Fire-Bricks.—At a recent meeting of the Society of Civil Engineers, Paris, a discussion took place on the possibility of obtaining higher temperatures in steel furnaces. At present the temperature is limited by that at which the walls of the furnace begin to fuse; and even Dinas fire-bricks are not proof against this. Magnesia is claimed to be capable of standing far higher temperatures than the Dinas brick. It is used, according to a statement made at the meeting referred to, by M. Lencauchez, and was first proposed by M. Müller in 1869. The principal difficulty in using it is the excessive shrinkage to which it is liable when heated. Thus a cube of magnesia of 10-inch edge, in the raw state, is said to shrink to one of 6-inch edge when sufficiently calcined. For this reason furnace linings made of this material were liable to crack badly. The remedy for this state of things is to cause the magnesia to undergo its maximum possible contraction before being placed in the furnace; but for this an excessively high temperature is required. These difficulties have, it is claimed, now been overcome; and M. Lencauchez showed the Society a number of perfectly solid bricks of magnesia which were as dense as granite, and had been thoroughly shrunk.

The Charcoal Pig-Iron Industry in the United States.—A report dealing with the manufacture of charcoal pig iron in the United States has lately been issued from the Census Office at Washington. It affirms that, notwithstanding the competition incident to the manufacture of steel and the lower-priced pig iron made with anthracite coal and bituminous coal and coke, the charcoal pig-iron industry retains its importance, especially in the States of Michigan and Wisconsin, and other localities where extensive deposits of iron ore and vast tracts of woodland, with a total lack of mineral fuel, favour the development of this industry. In 1880 there were 223 charcoal blast-furnace establishments in the States, which reported an invested capital of $27,909,919. The total cost of materials was $7,403,531; and the total value of charcoal, pig iron, and other products, was $12,575,996. The quantity of pig iron produced that year was 435,018 tons of 2000 lbs. In 1890 the number of establishments engaged in the manufacture of charcoal pig iron was 119; the total capital invested being $20,060,715. These works consumed materials costing $8,396,130, producing charcoal pig iron and other manufactures valued at $11,985,103. The quantity of pig iron produced was 664,497 tons. In compiling the statistics for 1890, special effort was made to exclude as far as possible the data relating to iron-ore mining, charcoal burning, and other industries dependent on the manufacture of pig iron; this information being covered by other branches of census investigation. The decrease in the total value of the product for 1890 is due to the fall in prices since 1880; the charcoal pig iron produced rising from 435,018 net tons in 1880 to 664,497 net tons in 1890—an increase of 229,479 net tons, or 52·75 per cent.

Experimental Conclusions on the Use of Sand Filters.—The German Imperial Sanitary Department have lately had under consideration the subject of the use of filtered river water for the supply of towns; the object of their deliberations being the exclusion as far as possible of danger of infection. Their conclusions have been given in the *Chemiker Zeitung;* and they may be summarized as follows: Care must be taken that the water used as a supply (river, lake, &c.) is as far as is feasible guarded against pollution by human excretions; and the mooring of vessels near the spot whence the supply is taken should be especially prevented. A sand filter does not yield a water absolutely free from germs; and as its efficacy in keeping back micro-organisms, including cholera germs, is limited, the demand made upon it must not be increased beyond a certain limit. The speed of filtration must be slow. In places where the consumption of water is so great that this is impracticable, remedial measures must be taken. This is effected either by a limitation of the consumption (for which purpose the introduction of water-meters in each house is recommended), or by increasing the surface of the filters and constructing additional filter-beds. Filters which have become clogged must be removed only so far that a stratum of sand more than 40 centimetres in thickness remains. The water first run off from a newly-built filter, or from one supplied with fresh sand, must not be allowed to flow into the clean-water reservoirs, or into the mains, as it is rich in bacteria. The performance of the filters must be daily checked by bacteriological examination. If greater numbers or unusual species of microbes suddenly appear, the water must be shut off from use, and precautions taken. It is even desirable to examine separately the filtrate from each filter. Careful attention to these directions reduces to a minimum the danger of the entrance of cholera germs into the water as supplied.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 899.)

THINGS last week on the Stock Exchange went from bad to worse. The week opened with apprehension, and soon became gloomier with another Australian Bank failure. Meanwhile in other quarters—the Foreign, American, and South African markets—the prospect of affairs was becoming sombre in the extreme. The settlement was nervously looked forward to. A rise in the Bank rate was regarded as a certainty—the only question being how much; and, when the bankers began to call in their money, there came such a pinch as has not been felt for a long time. Carrying-over rates rose enormously; and, in result, the "hammer" has been exercised ten times in the week. It is difficult to foresee clearly the course of things; but, in all probability, the present 3½ per cent. Bank rate will suffice until matters have settled down, and then money will become cheap again. The Gas Market meanwhile has been quiet and uneventful. Prices on the whole are rather easier, which is only natural, having regard to the higher value of money and the general fall in stocks, even the choicest. Still, the retrogressions in Gas securities are almost infinitesimal, and do not anywhere exceed 1 per cent. In Gaslights the "A" stock was fairly active; and the prices marked were pretty nearly as good as those of the preceding week, though the quotation was placed 1 lower. Nothing was done in the debenture and preference issues; but there were some transactions in the limited. South Metropolitans were comparatively inactive; and their figures showed no marked indication either way. A couple of bargains in Commercial old were done at good prices. Not a single transaction was recorded in any of the Suburban and Provincial Companies; but Alliance and Dublin old was quoted a shade better. The Continentals were quiet, like all the rest, and unchanged; Imperial coming in for most attention. Among the remoter undertakings, Melbourne debentures have fallen another point, from notorious causes; and Buenos Ayres and Monte Video show a little shrinkage. Water is quiet and steady; quotations being practically unchanged.

The daily operations were: The Gas Market was almost inanimate on the opening day; business being extremely restricted, and quotations did not move. There was a shade more activity on Tuesday; but still transactions were much below the average. Alliance and Dublin old improved ½; but Buenos Ayres debentures receded to a similar extent. Wednesday produced no change of any note, except that Gaslight "A" made a retrograde movement of 1. Thursday was as quiet a day as the rest; and the only variation was a fall of 1 in Metropolitan of Melbourne debentures. Friday was devoid of any special interest; and the quotation movements were limited to a fall of ¾ in Monte Video. Saturday was a rather active day for South Metropolitans; but otherwise it presented no special feature, and all quotations closed unchanged.

ELECTRIC LIGHTING MEMORANDA.

Extinction of the Electric Light in the House of Commons—The Danger of Transformers—An Appeal Case—The Electric Light at Leeds.

THE Westminster Electric Supply Corporation are to be compassionated upon a catastrophe that occurred during the night of Monday of last week, when, by the failure of a fuse, the whole of the lamps served by them in the precincts of the House of Commons went out for about half an hour—until, in fact, the fuse could be replaced by a new one. The mishap did not affect the House itself, which is fortunately still lighted by gas. It is hard to say what would be the consequences, in the state of political tension existing in Parliament at the present time, of plunging the House in even temporary darkness; for although there are several parties in Parliament, to some of which the term Obscurantist has been applied by their opponents, none of them would like their flow of oratory to be checked by such a concrete kind of obscurantism. The officials responsible for the lighting of the House must have regretted the overweening confidence which led them to trust to electricity for so many important ante-rooms, lobbies, and corridors as were involved in this failure. It was at first reported that the delinquent system was that belonging to the House, and not the additional service laid on by the Westminster Company; but this mistake was corrected by the official explanation of the First Commissioner of Works. We notice that one of the electrical journals, in its desire to screen the Company, asserts that the cause of the failure is not to be laid to their door, inasmuch as "the extinction was due to the melting of a fuse in the House itself, beyond the control of the Westminster Electric Supply Corporation, who furnish the current." Of course, if the fuse was not theirs, and was a bad one fixed by the Government fitters, the Corporation are not to blame for its failure. We believe, moreover, that up to this time the management of the undertaking have made it their boast that their supply has never failed to any consumer. We are far from desiring to affix blame where it is not due; but it is necessary to point out that the very necessity for interposing these safety fuses in an electric supply service seems to imply that they must occasionally come into use. This being so, and instantaneous extinctions of light from this cause being always possible, it appears that the only palliative permitted is to take such means as shall enable melted fuses to be replaced at the shortest notice and in the least possible space of time.

Melting fuses, however, are not the only troubles attending electric lighting from central stations. Where the system of distribution necessitates the placing of transformers on consumers' premises the occasional overloading of these appliances is said not unfrequently to set up a dangerous amount of local heating, which results in fires. It is even rumoured that the insurance offices may find it necessary to take further steps for ensuring the localization of fires arising in this way, which are more common than is yet generally known. The operation of these transformers is necessarily attended with the evolution of heat, as some of the electricity is lost in this form in the course of transformation from a high to a lower potential. Few transformers are worked up to their full capacity, or not for long; and the unfortunate consequence of this, from the companies' standpoint, is that when lightly loaded the transformer is most inefficient. On the other hand, the nearer its full load is approached the more dangerous the appliance becomes. It is stated that the natural fluctuations of demand in a town district served through transformers sometimes render it difficult to maintain the pressure upon the apparatus within safe limits, and then, if a few of the weakest were to go, the instantaneous burden thereby thrown upon the remainder might result in a general collapse. This is a difficulty that may be expected to increase as the distributing plant exposed to it becomes employed to its full capacity.

It will be seen by our report in another column that the case of *Loveland v. The Gaslight and Coke Company*, which refers to personal injuries caused by an explosion of gas collected in a street electric light box, has been carried to appeal from the Lord Mayor's Court, and that the judgment, which was against the Company, has been allowed to stand. Moreover, permission to appeal further was refused. It is unnecessary to repeat all the facts of this case, which possesses considerable importance for all gas companies. It is advisable to point out that the appearance of the electric light box in the case is, in the legal sense of the term, an accident. There was no question of electrolysis, inasmuch as there was an admitted escape of gas from the Company's main, which was being searched for at the time by digging up the road; and it was the plaintiff's case that this gas had collected in the street box, and was ignited by sparks from the workmen's picks. The Company's contention was that there was no negligence on their part to render them liable for damages caused by the explosion. The onus fell upon the Company; and although Counsel (Mr. Bigham, Q.C., and Mr. Morten) did their best for the appellants, the Court did not call upon Counsel for the respondent, but decided that the onus had not been discharged. Upon the face of it, the matter could hardly have gone otherwise. If the electric light box had not been where it was, the gas from the leaky main would not have collected in it, and the particular damage would not have been done by its explosion. But it might have occurred in a sewer, a cellar, or a lamp-post; and it is well that the consequences were not more serious.

The progress of electric lighting has found another exemplification with the opening last Wednesday of the Leeds central station by the Mayor. It is not a very large affair, and belongs to the Yorkshire House-to-House Company. This being a Hammond speculation, the plant has been characterized by the *Electrician* as being one of the usual type employed in similar undertakings—Fowler engines, rope driving, Lancashire boilers, and Lowrie-Parker alternators. The station has a capacity for 16,000 lamps, of which 10,000 are reported to have been already booked. A considerable amount of fuss was made over the occasion, as might be expected, for Mr. Hammond is inveterate in advertisement, and to actually get another of his House-to-House schemes at work is no small feather in his cap. It is difficult to understand why Leeds should have been confided to his care in this regard, unless it was because there was nobody connected with the Municipality able to undertake the responsibility. However, it may be a piece of Machiavellian artifice on the part of the Corporation, to prevent imaginary injury to their miscellaneously-managed gas property. It is natural that Leeds should have a central station for electric lighting; and the Corporation have saved money by having nothing to do with providing it. Upon general principles, however, it must be described as surprising that Leeds should have adopted this means of providing itself with the modern luxury of electric lighting. In all probability, some of the largest mills and warehouses in the town, having steam or gas power on the premises, are even now supplying themselves, which would go far to account for the small scale of the central station. There is not much profit to be made out of 10,000 or 20,000 lamps, although charged at House-to-House rates.

Issue of Additional Stock of the Tottenham and Edmonton Gas Company.—Our readers will see, by an advertisement which appears in another part of the JOURNAL, that the Directors of the Tottenham and Edmonton Gas Company are prepared to receive, not later than four o'clock on Friday, June 16, sealed tenders for £15,000 of "C" stock; being the second portion of the additional capital authorized by the Company's Act of 1882. The minimum price is 150.

THOUGHTS ON CARBONIZING, SUGGESTED BY THE YEADON REVOLVING RETORT.

The continuous and automatic carbonization of coal is one of those subjects—old, yet ever new—which are always with us, to baffle yet inspire. From the very earliest days of gas lighting, this subject has exercised a remarkable fascination for the thoughtful engineer; and it is natural and reasonable that this should be so. There is no problem within the whole range of gas engineering, the prospect of whose complete solution affords promise of such substantial and lasting rewards. The purification of gas in closed vessels is a desideratum whose attainment is sought chiefly as a means of abolishing the measure of nuisance, large or small, inseparably attendant upon the present system; though not without promise of coeval saving, to some extent, both in labour and cost of material. But however successful the process might be, it is hardly to be expected that it would be carried out more satisfactorily, as regards the degree of perfection obtained in the purified gas, than is attained under the present system. The fuller development into useful light of the wasteful heat of a gas-flame is another of those problems which have baffled the endeavours of more than one generation of investigators. Its solution, however, is at the present day pursued with greater zeal, fuller knowledge, and with brighter (because more wisely-regulated) hopes. Yet the complete conversion of the mere heating effect of a gas-flame into one of lighting also, though "'tis a consummation devoutly to be wished," would do nothing towards cheapening the cost of gas, though it would enormously decrease the cost of *gas-light*. To the manufacturer of gas it might therefore not come as an altogether unmixed blessing. But the full realization of that dream of the gas maker—continuous automatic carbonization—is looked forward to for affording relief from certain at present unpleasant and extremely arduous operations; for effecting considerable economy in the carrying out of those operations; and, more than all, for accomplishing the carbonization of the coal more perfectly, and with the production of better results than are at present obtained. No wonder then that there have been many adventurers into the field for invention herein laid open; that there have been many attempts to wrest the secret, overcome the difficulties presented, and seize the rewards laid up for the successful.

The latest attempt to achieve the hitherto unaccomplished is that of the Yeadon and Adgie system of carbonizing, whose patent revolving retort was described and discussed at the recent meeting of the North of England Gas Managers' Association. The invention has already been referred to at some length in our columns, while the different modifications of the apparatus have been described and illustrated, from time to time, in our "Register of Patents." There are however some points of novelty about the Yeadon retort, which illustrate and bring more prominently to view than has been brought before, certain features in the carbonization of coal that have not hitherto received the consideration they deserve. It is, therefore, from a theoretical rather than a practical point of view that it is intended now to discuss this invention; and this we would have, at the outset, distinctly understood. Without prejudice to whatever it may be found necessary eventually to say as to its actual performance—by which alone will its value and lastingness be ultimately determined—for the present let us use the Yeadon retort as a text upon which to hang the thoughts it has awakened.

The unique and main feature of the Yeadon retort is, of course, the fact of its revolving on a horizontal axis. Clegg invented a retort which revolved on a *vertical* axis; but, apart from this distinctive difference, there was the radical and—as regards Clegg's invention—fatal one, that his retort was alternately exposed to the heat of the furnace and withdrawn from that influence. In the more recent invention, the whole surface of the retort is constantly and equally exposed to the fire or heating gases. In an ordinary gas retort, heat is conveyed from within the setting to the coal inside the retort by conduction and by radiation. (To a very slight extent convection also comes into play—the vapours liberated in one portion of coal carrying heat to another; but this must be so very insignificant in amount that it may well be neglected.) Only the floor of the retort, together with a small portion of its side walls are utilized for heating by conduction; while the roof and greater part of the sides convey heat by radiation only. True, the latter conduct heat to the gases and vapours that are evolved from the coal. But the abstraction of heat by these must be very small compared to that by the other; and it is doubtless correct, in the main, to say that the great bulk of heat transference takes place through the medium of the retort floor. In the revolving retort, however, there is a very different state of things. Its revolution causes the whole surface of the retort to be brought into active and equal operation in heating the coal exposed to its influence. Each and every portion of the retort becomes, in turn, floor, side, and roof; and so, not only does it convey heat more rapidly and completely to the coal (because heat is much more readily transferred by conduction than radiation), but also it is itself more equably heated, so conducing to its longer life.

Another important feature is the frequent or continuous turning-over of the coal which is brought about by the rotary motion of the retort, aided by the longitudinal ribs or blades in its interior. In an ordinary retort, heat is conveyed to the coal, as already stated, chiefly by conduction through the medium of the floor of the retort. Now coal is an extremely bad conductor of heat, and consequently the portion of the charge next to the retort becomes completely carbonized long before the heat has penetrated into the interior of the mass sufficiently to distil it. The result is that a section of an incompletely carbonized charge of coal would present a thick lower, and a very thin upper crust of more or less well-burnt coke, with an inner core of raw coal. These conditions may be expected to operate to the detriment of the products of distillation in two ways. On the one hand, the newly evolved vapours from the lower crust of coal—the first to be carbonized—are probably to some extent condensed in passing through the interstices of the cold coal; while, on the other hand, the gas which is evolved from the interior of the mass, after a crust of incandescent coke has formed, as stated, on the outside, must, in passing through the latter, be considerably deteriorated. The coke gains by this means, in richness and firmness, at the expense of the gas and tar. (Incidentally it may be suggested whether the inferior and almost worthless coke said to be produced in the Yeadon retort, is not to great extent the result of this condition of things being obviated by that invention.) Apart from the reduction in value of the illuminating gases by their passing over the incandescent coke—carbon being deposited, and gases less rich in that constituent formed—there is also the danger of forming bisulphide of carbon through the decomposition of sulphuretted hydrogen, as follows: $2\ H_2S + C = CS_2 + 2\ H_2$.

The agitation or turning over of the coal in the Yeadon retort, besides bringing fresh surfaces of coal into contact with the surface of the retort, and so greatly facilitating the conduction of heat throughout the whole charge, must also, by its breaking up the fused and intermixed mass, considerably aid the liberation of gas therefrom. When the latter has to force its way through a hard resisting crust of coke, it must require more energy, which means more heat, to do it. Another advantage which this agitation of the contents of the retort may be expected to confer, is freedom from carbon or scurf—an advantage not to be despised; and in one sense of more importance in the revolving retort (where heat supplied by conduction is more utilized) than in the stationary, because carbon is a bad conductor, though a good radiator, of heat.

It is noteworthy that the inventors appear to have found it necessary or advisable, in developing their invention, to alter the material of which the retort is made. In their original specification, it is shewn and described as of fireclay; their latest modification however, and that described at the North of England Association meeting, is of iron. Probably much lies in this; of which the import may be seen in what follows.

There is considerable misapprehension as to the temperature at which gas is evolved from coal—the extremely high heats now commonly employed in gas making leading to the inference that such intensity of heat is really that at which the coal is (and is best) distilled. Neither of these suppositions is correct. Coal distils at 700° Fahr., and gives off its gas freely at from 1000° to 1100° Fahr. The vapours given off at the lower temperature would, if immediately cooled down to the temperature of the atmosphere, become to a great extent liquid; but being subjected, while still vaporous, to a higher temperature, permanently gaseous products are formed. The temperature necessary for this transformation is, however, one of not higher than 1600° Fahr., or (say) a cherry red. Could heat of this intensity be supplied as fast as it is absorbed by the volatile products, no higher temperature would probably, as regards gas making, be needed. It is, however, because the ordinary fire-clay retort is incapable of supplying this heat, with the requisite facility and abundance, that such an excessive temperature of distillation is usually employed; in order that the excess or reserve of intensity may compensate for what is lacking in quantity. Now the revolving retort, besides utilizing the whole of its surface for heating by conduction is also, as regards the material of which it is made, a much better conductor of heat. The capacity of iron for conducting heat is greatly in excess of that of fire-clay. It is these various causes combined which enable the Yeadon retort, if the reports to hand are to be relied upon, while heated to a temperature of only 1500° or 1600° Fahr. to liberate the gas from coal with much greater celerity than by the ordinary method.

Errors of Water-Meters.—The errors of water-meters are discussed by Mr. C. F. Chase, Superintendent of the Taunton (Mass.) Water-Works, in a recently-issued report. He states that, during the last ten years, 92 tests of meters have been made in that city by the Water Department. In 21 cases the meter registered correctly; in 36, it showed an over-registration; and in 35, an under-registration. The maximum error against the consumer in any case was 4·6 per cent.; the minimum error, 0·1 per cent.; and the average error, 1·69 per cent. In the cases of under-registration, the minimum error in favour of the consumer was 0·2 per cent.; the maximum error, 25 per cent.; the average error, about 4·25 per cent. The average of the whole 92 tests was 0·97 per cent. in favour of the consumer.

THE LIABILITIES OF WATER COMPANIES.

In these days of sunshine and drought, it is difficult to pay much heed to the special perils which beset a water company during what may be described as the season of frost and bursts. Nevertheless, to be forewarned is to be forearmed; and those who have to pilot the companies in these troublous times will do well to note a curious decision recently given by Judge Jordan in the Newcastle (Staffs.) County Court. The case of *Vickers and Wife v. The North Staffordshire Water-Works Company* was reported in last week's JOURNAL; and the judgment delivered, if followed by other learned Judges, will certainly suggest the consideration of familiar incidents in a somewhat novel light, and attended with somewhat unreasonable results. Even the water companies, much as is required at their hands now-a-days, have no means of checking the operations of King Frost; and when water freezes, accidents must sometimes happen. This was the case at Newcastle last February, when Mrs. Vickers, the female plaintiff in the action referred to, walked on to a sheet of ice, slipped, and broke her wrist. Now, it so happened that there was a joint in the Water Company's main close to the spot where the lady fell; and, upon the ground being opened, there was, found to be a leakage, owing, it was alleged, to a loosening of the "packing." The pipe, it should he added, was laid in clay, so that the water escaping from the joint could not percolate; and it consequently rose to the surface, where it froze, and gave rise to Mrs. Vickers's accident. The above is the plaintiff's version of the case. For the defendants, witnesses were called to show that the accumulated water had descended from an old field drain, which discharged itself about 5 yards higher up the road, on an incline descending to the spot where the mishap took place. It may be assumed, however, that the Judge was right in the view he took of the facts. For the purpose of these remarks, it matters not one way or the other. The point lies in the construction which his Honour placed upon the law as applicable to what can only be viewed as an ordinary accident—a construction which, in our opinion, was highly technical, not to say very far-fetched. We are by no means certain that a superior tribunal would unreservedly endorse it.

The defendant Company raised no plea of *vis major*, but contended that, even if the leakage from the main had brought about the mischief, it was a leakage of which they received no notice before the accident; and that neither they nor their servants had been guilty of any personal negligence. These two important points the Judge affirmed in favour of the Company. It may be added that, for another condition contributing to the mishap—namely, that the main was laid in a clay soil—the Company could be in nowise responsible. Why, then, should the plaintiffs have succeeded in their claim for damages? The answer is to be found in Judge Jordan's interpretation of a decision given by the House of Lords some years ago upon a totally different state of facts. The learned Judge, guided, or misled, by that decision, ruled that the North Staffordshire Water Company, though guiltless of any sort of negligence, were liable for a latent defect which ordinary prudence and skill could not have detected. This, assuredly, is a strong thing to say in regard to the facts proved in the County Court; so strong that we venture, without disrespect to the County Court Judge, to submit that the decision is not unimpeachable. What weighed with his Honour was Lord Blackburn's *dictum* that a person who, for his own purpose, brings on his land and collects and keeps there anything which is likely to escape and do mischief, must keep it at his own peril. This principle Judge Jordan seemed to think applied *a fortiori* where water was brought on to a public highway. This, however, is a proposition which, as applied to this particular case—the Company having laid the main in pursuance of their statutory powers—we take leave to doubt. If the plaintiffs could have shown any sort of negligence on the part of the Company, of course it would have been another matter. Then, again, but little, if any, consideration appears to have been bestowed upon the point that, the accident having occurred in broad daylight, the female plaintiff was guilty of contributory negligence in going on to the ice. On the whole, therefore, the judgment, though, doubtless, painstaking and conscientious, cannot be regarded as satisfactory. It may not be worth the Company's while to carry this particular case any further; but it would certainly be advantageous to water companies in general that the questions involved should receive consideration at the hands of a more authoritative tribunal.

The Permanent Secretaryship of the Board of Trade.—The President of the Board of Trade has appointed Sir Courtenay E. Boyle, K.C.B., to be the Permanent Secretary of the Board of Trade, in the place of Sir Henry G. Calcraft, K.C.B., whose retirement was noticed in the JOURNAL last week.

Books Received.—"Centrifugal Pumps, Turbines, and Water Motors," by Charles H. Innes, M.A., Lecturer on Engineering at the Rutherford College, Newcastle-on-Tyne. (The Technical Publishing Company, Limited, Manchester.) "Profit-Sharing and the Labour Question," by T. W. Bushill (a profit-sharing employer); with introduction by Mr. Sedley Taylor. (Methuen and Co., London.)

COMMUNICATED ARTICLE.

COAL GAS: ITS MANUFACTURE, DISTRIBUTION, AND CONSUMPTION.

A Series of Articles for Gas Students.

(*Continued from p.* 823.)

GASHOLDERS.

Gasholders without Guide-Framing.

The object of the outer guide-framing is, in short, to prevent tilting of the holder. This, it is obvious, cannot take place while the latter both maintains the true vertical position and perfectly retains its form or shape. The subject of dispensing with outer guide-framing can, therefore, only be practically considered upon the assumption of the two following primary conditions: First, the maintenance of the base of the holder, or of each lift in a telescopic holder, in a *perfectly horizontal plane;* secondly, sufficient rigidity of the holder itself to enable it *unaided* to retain its form perfectly, under whatever stress or strain it may be subjected to (due to wind pressure, unevenly-distributed weight of snow, binding of the bottom guide-rollers, &c.). Ordinarily, such strains are in great part transmitted direct to the outside framing; but, in the absence of this, they have to be met by the holder itself, being concentrated chiefly at a point a little above the base of the holder or lift, and thence transmitted, in part, to the base and to the tank walls. The play and elasticity allowed to the base is, owing to the first-named condition, necessarily but very little, or nothing; hence its very rigidity would tend to intensify the strains on the sides of the holder. These two conditions are thus essential to each other; the second being necessitated by the means employed for the successful application of the first. There are at present only two systems in operation, which may be considered to practically fulfil these conditions—viz., the spiral guides for bottom rollers, and the wire-rope system. According to the former system, the ordinary vertical guides in the tank and the outer lifts are replaced by inclined or spiral guides. The rollers are so fixed on the base of the holder or lift, and either radially or tangentially to it, as to closely fit these inclined guides, up and down which they travel. The holder, therefore, has a spiral or screw-like motion as it rises and falls, and tilting, or the inclination of the base from the horizontal plane, is impossible; while the substitution of the spiral for the vertical form of guide inside the outer lift is an important source of strength and rigidity. There are now many holders constructed upon this principle (the invention of Mr. W. Gadd, of Manchester); one of the latest examples being the holder at Longport, which was recently inspected by a party of gas engineers (see *ante*, p. 633). The writer is informed that the deflection of this holder under a very severe wind storm was not above one-eighth of an inch. In the second system, a series of steel wire ropes are employed, and arranged in accordance with the following principle: In a tilting holder, the rise on one side must be attended by an exactly equal fall on the other. If, then, the rise on one side can be effectually controlled and confined to that of the other, no tilt can take place. To effect this, three or more ropes or wires are passed over the holder, or otherwise arranged so that the bottom curb is, at various points on its circumference, connected to corresponding points on the top curb, but on the opposite side of the holder. The connecting ropes pass over pulleys fixed at the ground or other level, and "pay out," as it were, to the rising top curb just so much length as is released by the rising bottom curb on the opposite side, and no more; and *vice versâ*, as the holder descends, the fall of the bottom curb is controlled by the amount of rope given out by the top curb on the opposite side of the holder. A rise of one point in the top curb coincident with a fall of any point in the bottom curb is therefore impossible; and tilting is thus effectively guarded against.

The present article must now be brought to a close with the following extracts of specifications culled from Mr. Newbigging's "Handbook," and inserted to assist the student in forming a definite idea of the sectional forms and areas of the various parts of gasholder construction. The subject has necessarily been treated only in outline; the object of the writer being simply, as already intimated, to give to the student a general idea of the ordinary methods of construction—special reference to underlying principles and modern developments, or the calculation of stresses and strains, being designedly omitted.

Single Gasholder (Trussed Roof).

Diameter, 100 ft. Depth, 20 ft. Rise of crown, 5 ft. Two crown plates, 5 ft. diameter, $\frac{3}{8}$ in. thick. Roof sheets, inner and outer circles, No. 10 B.W.G.; the remainder, No. 12, except carriage sheets, $\frac{1}{4}$ in. thich. Side sheets, top and bottom tiers, No. 9 B.W.G.; the remainder, No. 12. Rivets, $\frac{5}{16}$ in. diameter, 1 in. pitch. Centre pipe, 14 ft. long, 24 in. diameter, $\frac{5}{16}$ in. thick. 18 main and 18 secondary bars. Top curb, two rings of L-iron, 4 in. by 4 in. by $\frac{7}{16}$ in. Bottom curb, two rings of L-iron, 4in. by 4 in. by $\frac{7}{16}$ in., and a flat bar of wrought iron, 6 in. by $\frac{3}{8}$ in. Eighteen vertical stays of T-iron, 4 in. by 4 in. by $\frac{3}{8}$ in. Nine columns, 24 ft. long, 24 in. diameter at the base, 18 in. diameter

at the top, 1¼ in. to 1 in. metal, and four holding-down bolts, 8 ft. long, 1½ in. diameter.

Two-Lift Telescopic Gasholder.

Diameter of outer lift, 120 ft.; depth, 24 ft. Diameter of inner lift, 118 ft.; depth, 24 ft. Rise of crown, 6 ft. Roof, untrussed, resting when down on timber framing in tank. Roof sheets, first or outside row, ⅜ in. thick; second row, ¼ in. thick; third row, $\frac{5}{16}$ in. thick; fourth row, No. 8 B.W.G. Crown plates, ¼ in. thick and 6 ft. in diameter; inside row, next crown plate, $\frac{5}{16}$ in.; next, No. 8 B.W.G.; and the remaining ten rows, No. 11 B.W.G. Side sheets, inner lift, twelve courses high; top and bottom course ¼ in. thick; second course at top, $\frac{5}{16}$ in. thick; remainder, No. 12 B.W.G. Side sheets, outer lift, twelve courses high; top and bottom course, ¼ in. thick; second course at bottom, $\frac{5}{16}$ in. thick; and the remainder, No. 12 B.W.G. Thicker sheets riveted with ⅝ in. rivets, 1¼ in. pitch; other sheets, $\frac{5}{16}$ in. rivets, 1⅛ in. pitch. Top curb, two L-irons, one at the junction of roof with side sheets 5 in. by 5 in. by ⅜ in., and the other at the inner edge of the outer row of sheets, 4 in. by 4 in. by ½ in.; the two stiffened by gusset pieces springing from the vertical stays. Bottom curb, two 5 in. by 4 in. by ⅝ in. L-irons, riveted to the outside of the lower row of sheets with ⅝ in. rivets 6 in. apart. Between these two curbs, which are placed 2 inches apart, are fixed the 28 guide-roller carriages. Cup formed of rolled channel-iron, 8 in. by 3½ in. by ½ in. riveted to the side sheets and rising plates with ¼ in. rivets 4 in. apart. A half-round bead 2 in. by ⅝ in. being riveted to the edge of the rising plates, which are ⅜ in. thick and 18 in. deep. Vertical stays, 28, formed of two 4 in. by 4 in. by ½ in. L-irons and a web-plate between, ⅝ in. thick and 9 in. wide, secured with ⅝ in. rivets 6 in. apart. At the upper end of these is attached a gusset-plate with L-iron edges 3 in. by 3 in. by ⅜ in., extending to the inner L-iron curb of the roof, to which and the outer curb it is riveted. Standards, 14, in the form of the letter T, 4 ft. 2 in. by 3 ft. at bottom, tapering to 1 ft. 9 in. each way at the top; each standard 51 ft. high. Between the L-iron framework of the standards is cast-iron trellis-work 1 in. thick, on one of its sides, and wrought-iron lattice-work on the other; the standards being secured to cast-iron hollow base-plates 6 in. deep. There are four holding-down bolts to each standard, 11 ft. 6 in. long and 2¼ in. diameter. Lattice girders, two rows in the height—the first or lower row 27 in. deep, the top row 30 in. deep—formed of four angle-irons 3 in. by 3 in. by ½ in., wrought-iron tension bars 3 in. by ½ in., and cast-iron struts.

Roof Framing of a 149-Feet Telescopic Gasholder.

Centre column, 3 ft. 6 in. diameter and 22 ft. long, 24 main radial T-iron bars, 6 in. by 4 in. by ½ in., curved to roof, each with a main tension-rod 2 in. diameter at the curb, reduced to 1½ in. at the foot of the centre column, and having a coupling-box with right and left hand thread. Four struts and four tension-rods form the bracing to each main bar—the former of + iron 4 in. by 4½ in. by ¾ in. placed vertically, and the latter of 1 in., 1⅛ in., 1¼ in., and 1⅜ in. round iron placed diagonally; the strongest section being nearest the centre column. There are 48 secondary radial bars of 4 in. by ½ in. flat iron; that is two equidistant between each main radial bar, and extending from the top curb towards the centre a distance of 26 ft., and then for a further distance of 16 ft. in the direction of the centre, another bar of like dimensions is fixed. There are 17 rings or rows of purlins, divided equally from curb to centre, fixed between the main and the secondary bars. The first row from the centre is of 6 in. by ½ in. flat iron; the next four rows, of 1½ in. by 1½ in. by ¼ in. L-iron; the next row, of 2 in. by 2 in. by ¼ in. L-iron; the next row, of 3 in. by 6 in. by ½ in. T-iron; the next two rows, which are subdivided in length by the secondary radial bars above mentioned, of 1½ in. by 1½ in. by ¼ in. L-iron; the next row, extending from main bar to main bar, of 3 in. by 6 in. by ½ in. I-iron; the next two rows, divided in three lengths between the main bars by the secondary bars, are of 1½ in. by 1½ in. by ¼ in. L-iron; the next row, extending from main to main, of 4 in. by 6 in. by ½ in. T-iron; the next row, divided in three lengths as before, of 1½ in. by 1½ in. by ¼ in. L-iron; and the remaining two rows, divided in three as before, of 2 in. by 2 in. by ¼ in. L-iron. Three bars of flat iron, 2½ in. by ⅜ in., cross diagonally in each bay formed by the two main bars.

Errata.—In line 35, p. 822, of the JOURNAL for May 9, for "vertical bearers or rafters," read "horizontal bearers or rafters, following the curve of the crown, which also radiate to," &c. Line 45 in the first column on p. 823 should read: "and on the inside of the outer lift suitable guides are provided," &c.

The City of London Electric Lighting Company's Depreciation Fund.—The City of London Electric Lighting Company have before Parliament a Bill to alter and amend the provisions of the City of London Electric Lighting (Brush) Order, 1890, the City of London (East District) Electric Lighting Order, 1890, and the City of London Electric Lighting (Brush) Order, 1891, with respect to the keeping of accounts and setting aside of depreciation and reserve funds, and to alter or prescribe the amounts to be debited to the annual accounts of capital employed for the purposes of these Orders for depreciation and for reserve and other funds.

TECHNICAL RECORD.

MANCHESTER DISTRICT INSTITUTION OF GAS ENGINEERS.

Nearly seventy members and visitors attended the excursion meeting of this Institution, which was held last Saturday. The programme promised a day of varied pleasure, which was amply realized. Meeting at the Central Station, Manchester, the party travelled in saloon carriages, attached to the 10.20 a.m. train, to Northwich. There they lunched at the Crown and Anchor Hotel, which has undergone great transformation since the Institution last visited Northwich some years ago. On that occasion the programme included a visit to a salt mine, and inspection of the Anderton hydraulic lift, by which boats are transferred from the River Weaver to the canal, which is at a much higher level. This time Northwich was the starting point for a journey down the Weaver to its junction with the Manchester Ship Canal at Saltport; and thence down the canal to Eastham Locks. This trip was most enjoyable. The Weaver pursues a winding course through diversified scenery; and after Northwich and its chemical works were left behind, the voyage was delightful. The distance from Northwich to Saltport is some 15 miles; and the length of the Ship Canal then traversed about 12 miles. Much interest was taken in this first completed section of Manchester's great undertaking, which most of the party passed over for the first time. The voyage, made by steamer, occupied the whole of the afternoon. On arriving at Eastham, the party had tea at the Ferry Hotel. Subsequently they crossed to Liverpool, and returned to Manchester by train. Throughout the day the weather was delightful; and the arrangements made by Mr. Samuel S. Mellor, the Hon. Secretary, for the comfort of the party proved completely successful.

The business part of the day's proceedings occupied a very few minutes at the close of the lunch at Northwich. The President (Mr. W. R. Chester, of Nottingham) occupied the chair. The minutes of the last meeting, which was held in February at the Palatine Hotel, Manchester, were confirmed; and one new member—Mr. T. N. Ritson, the Manager and Engineer to the Kendal United Gas and Water Works Company—was formally elected. After this there was a little conversation as to the arrangements for The Gas Institute meeting at Belfast; and this was all the business.

THE GASIFICATION OF COAL AND LIQUID HYDROCARBONS.

At the Meeting of the London Section of the Society of Chemical Industry on Monday, the 1st inst., at Burlington House—Mr. W. THORP, B.Sc., F.I.C., presiding—Dr. P. DVORKOVITZ read a paper on the above subject.

The author commenced by briefly sketching the history of the artificial production of burning gases; and, in referring to the inventors of coal gas—Murdoch and Winsor—he said that they possessed a very small knowledge indeed of the chemistry of the gas they produced. Even up to the present day, the subject of the gasification of coal and liquid hydrocarbons had not received that study by chemists to which it was entitled; and it had been left to the engineer to devise all the improvements to arrive at more economic working, but by the same original method. Chemists had devoted themselves to the study of certain bye-products, which the engineer created; but to the chemistry of the material with which the engineer dealt, not so much attention had been paid.

Dealing first with the gasification of coal, and the results obtained thereby, he mentioned the gases produced from coal under three heads: *a*, Lighting gas; *b*, gas carriers; and *c*, foul gas. According to some analyses of coal gas made by Professor Foster in 1891, they saw that the first-named elements (*a*) were formed in very small quantity, as compared with the bulk of the gas. The illuminants or unsaturated hydrocarbons (*a*) were represented by 4·35 to 7·88 per cent.; while the second series (*b*) ranged from 89 to 92 per cent.; the balance being foul gases—say 0·4 to 14 per cent. The bye-products were about 10 gallons per ton of coal. All kinds of coal contained from 50 to 70 per cent. of fixed carbon, and from 40 to 50 per cent. of volatile matter; and the latter defined the goodness of the coal for the purpose of gasification. This being so, he asked how it was that, by the analyses of Professor Foster, the percentage of the hydrocarbons in coal gas was so small—viz., 6 per cent., or per ton of coal 600 cubic feet by volume, and 42·2 lbs. by weight. Having called attention to a table showing the analysis in volume and weight of gas when 10,000 cubic feet were produced from a ton of coal, he proceeded to remark that, the average quantity in weight of volatile matter obtained from a ton of coal (supposing they took 35 per cent., instead of 45 per cent., so as to allow of 10 per cent. for the bye-products and liquors) being 784 lbs., the quantity actually obtained by the present method of gasification was only 303·2 lbs. as gas, or a little more than one-third—the rest being lost or converted into solid substance. What was still more important, however, was that, of this one-third, only 42·2 lbs., or about 5 per cent. of the whole, consisted of unsaturated hydrocarbons or illuminants.

The question as to how the two-thirds of the volatile matter

in coal were lost in the present process of gasification was next treated upon by the author; and he prefaced his remarks on this point by referring to the well-known fact that, gas taken for analysis from the retort at different times, varied in its composition according to the time at which it had been drawn off. This, he said, showed that the quantity of light-giving gases depended upon two factors—(1) The quantity of the compounds which, under a certain temperature, would crack and give away light-yielding elements; and (2) the temperature to which these compounds were subjected. In the present method of the gasification of coal in retorts, there existed all the conditions for destroying the gas formed. It was carried on at a high temperature; and the hydrocarbons, passing through the highly-heated mass, threw off the hydrogen in such large quantities that this gas represented nearly 50 per cent. of the whole of the gas made, in addition to which a quantity of nitrogen produced from the broken-up hydrocarbons was consumed by the oxygen in the coal, and a further quantity went with the nitrogen to form ammonia. Therefore, he held, gasification must be carried on at a lower temperature, the result of which would be that the unsaturated hydrocarbons would be preserved, a maximum candle power obtained, and also a larger quantity of hydrocarbons of the benzene series. At this point he explained that he had assumed that all coal was a substance which might roughly be described as a fixed carbon saturated with hydrocarbons, and that these for the most part belonged to the paraffin series.

Dr. Dvorkovitz devoted the next section of his paper to the subject of the gasification of liquid hydrocarbons; and mentioned, at the outset, that the first apparatus for making oil gas, as far as he could learn, was patented by Mr. P. Taylor in 1824. From that time to the present, the main principle of passing gas through an intensely heated surface had been adopted by all the patentees of oil-gas apparatus; and their second idea had been to gasify the whole of the oil treated without having any residue whatever left. The consequence had been they had all more or less failed. Little attention, however, had been paid to the few, but still serious, attempts which had been made in the scientific world to obtain valuable bye-products. He claimed that the first rational process (patented in the year 1877) for the gasification of oils belonged to Professor Lietny, of St. Petersburg. His method was improved upon by Dr. Smith, at the works of Mr. Ragosine, in Russia; and it was due to the financial sacrifice of the latter gentleman that they had been able to define the full usefulness of naphtha to produce gas of high illuminating power, and at the same time a large quantity of valuable bye-products. At those works, attention had mainly been directed to the utilization of those mineral oil products obtained by the distillation of Russian crude oil which could not be used in oil-lamps on account of their heavy specific gravity, and which were too light to be employed as lubricants. These products comprised nearly 20 per cent. of the Baku crude oil. Though the work carried on there was principally with the view of obtaining the bye-products which were so valuable, and which amounted to 40 per cent. of the oil treated, yet, even under such conditions, they produced about the same quantity and quality of gas per gallon of oil used as, according to the latest published information, had been realized in England, where no valuable bye-products were obtained. This he attributed to the fact that in Western Europe and America, the attention of the investigators and inventors had been directed to naphtha products and other oils only from the point of view of how to procure the largest quantity of gas possible; while in Russia, where the gas industry was in its infancy, chemists had spent their energies on the bye-products, regarding the gas question as a secondary one. Both the Russian distillers and foreign gas companies had therefore been equally wasteful—the first wasting the gas, and the latter the bye-products.

For his experiments upon liquid hydrocarbons, Dr. Dvorkovitz took three different distillates—viz., (*a*) Solar distillates of the specific gravity of ·8625; (*b*) solar distillates of the specific gravity of ·8853; and (*c*) a specially prepared distillate of the specific gravity of ·899. By distillation of sample *a*, at temperatures ranging from 0° to 350° Celsius, he obtained 67 per cent. of a product of the specific gravity of ·8442. By distillation of sample *b*, at the same temperatures, he obtained none at all; but, from sample *c*, 28 per cent. of a distillate of the specific gravity of ·8607 was obtained. The three distillates were subjected to the same process of gasification—the apparatus used consisting of two iron pipes laid horizontally, one above the other, and connected together at one end. The other end of the upper pipe was carried up vertically about 6 inches; and into the top was inserted a glass funnel, with a stopcock. The other end of the lower horizontal pipe was connected with a condenser, for collecting the bye-products, which, in its turn, was connected with a gasholder for receiving the gas. The author here called attention to a table, which showed very clearly the difference between the results obtained by gasifying at a high and at a low temperature. The illuminating power of the gas produced at a temperature of 1600° Fahr. was only half that of gas produced at a temperature of 1300° Fahr. If a still higher temperature was employed, the gas was again of a lower illuminating power. It was also observed that, by gasifying the three samples of oil, *a*, *b*, and *c*, at the same temperature, very different results were obtained; and that the best result was realized from *c*, both as regards quantity and quality of gas and bye-products. The lightest sample *a* certainly produced a few feet more of gas; but the illuminating value was only 665 candles, as compared with 832 candles with sample *c*. Then the percentage of bye-products in the case of sample *a* was 37·5, of a specific gravity of ·9266; while in the case of sample *c*, it was 38 per cent. of the gravity of ·967. The difference so far as quantity was concerned was slight; but, in the value of bye-products, it was very great. The analysis of the bye-product in the case of sample *a* showed that it contained a considerable quantity of light spirits, mixed with the benzol, which mixture it had proved impossible to separate by fractional distillation, owing to the boiling points of the two being so nearly approximate. The presence of these spirits in the benzol was only ascertained by gravity, and not by the boiling point—benzol, mixed with spirit, having a much lower gravity than pure benzol. On the other hand, the analysis of the bye-product obtained from sample *c* revealed that it mainly consisted of pure benzol, with very little light spirit.

Reverting to the gasification of the volatile matter in coal, the author said the most important part of the process was to crack the saturated hydrocarbons into unsaturated hydrocarbons, which were the illuminating elements. It seemed to him that, beginning with the first invention of coal gasification up to the present time, the method which resulted in obtaining only 42·2 lbs. of unsaturated hydrocarbons out of 784 lbs. of volatile matter could not stand scientific or practical criticism. Guided by the results of experiments in oil gasification, and having come to the conclusion that liquid hydrocarbons existed in coal, he thought of gasifying coal on the same principles as oil, in order to avoid the destruction of the volatile matters which was brought about by the present methods. But he had been prevented at the outset by the absence of any means of carrying out this purpose; and therefore he determined to adopt a combination process of distillation and gasification in the presence of an inert gas, for the purpose of mechanically taking off, or rather squeezing out, those hydrocarbons which, as stated previously, he had concluded existed in the coal in liquid form. The inert gas which he had found to be most suitable for this purpose had appeared to be pure hydrogen, or else a mixture of hydrogen and carbonic oxide. He had also used pure nitrogen; but he found that the cracking up of the oils went farther in this case. The inert gas itself prevented the hydrocarbons from touching the surface of the apparatus, and so being subjected to great heat; while the presence of hydrogen kept the hydrocarbons from splitting up. By this method of gasification, he had obtained 16 per cent. of coal oils. The gas obtained in the first operation by his process was equal to about 5000 cubic feet per ton of coal; the illuminating power ranging from 17 to 22 candles—or (say) an average of 20—equal to 20,000 candles per ton of coal. In the first process of the gasification of the coal, the author obtained (as already stated) 16 per cent. of coal oil. On subjecting this to distillation, he realized, at temperatures ranging from 0° to 360° Celsius, 38 per cent., or about 13½ gallons, of rich gas oil. Taking this and subjecting it to the process of gasification, he produced a quantity of illuminating gas, equal to 11,000 candles per ton of coal; so that it would be seen that the actual total number of candles per ton of coal eventually obtainable by this method was 31,000, in addition to which the residue resulting from the gasification of the 38 per cent. of gas oil possessed the same value as the bye-products obtained from the gasification of petroleum oil.

Summing up the matter, Dr. Dvorkovitz said that, by his process, they obtained, in the first instance, 31,000 candles per ton of coal treated, about 8 gallons of paraffin, a small quantity of pitch, and 4 gallons of bye-products of great value from the gasification of the gas oil. To completely carry out this method of coal gasification, it was essential to divide it into two distinct operations; but he confessed that he had not found the means of doing this. There should first be a process of coal distillation for the purpose of extracting, in an intact form, the whole of the hydrocarbons which the coal contained; and, having obtained these, they should be subjected to the process of gasification in the same way as any other liquid hydrocarbons. It was evident that it was more economical to divide the processes of distillation and gasification, seeing that the conditions under which the various series of hydrocarbons were formed were so complex, that it was impossible to apply the necessary conditions in one operation. If they attempted to do so, in securing some hydrocarbons, they would naturally destroy others. He thought he was justified in saying that the obtaining of paraffin in such quantities as he had done was ample proof that his assumption that coal was a substance comprising fixed carbons saturated with hydrocarbons was well founded. It was an interesting fact also that the existence of paraffin in coal was not limited to that class of coal called gas coal, as, on subjecting a sample of ordinary house coal to the same process of gasification, he obtained almost a similar quantity of coal oils, and about the same amount of paraffin.

In conclusion, the author said that, although he had been working at this subject for some little time, it was one that was so complex and vast that it might be said he had arrived only at a preliminary stage—in fact, the ground to be covered was so extensive that the labours of one individual could hardly ever accomplish it; but the fact that all coal contained paraffin in so large a quantity appeared to him to be of such importance to the gas industry that it would interest the members to know

the progress he had made up to the present time. In addition to the advantages already enumerated, there were others of perhaps less importance—such as the obtaining of a far larger quantity of superior coke absolutely free from sulphur; and of an increased quantity of ammonia. He admitted that the lines he had sketched out would necessitate such a radical revolution in the method of gas manufacture, that he could hardly anticipate a change of such enormous importance could be carried out rapidly; but he trusted that, having pointed out the possibilities that existed for the improvement of the industry, the attention of gas engineers and chemists would be directed to it, and the present wasteful method might, at any rate, be somewhat ameliorated.

In the course of the discussion which followed,

Professor VIVIAN B. LEWES said he had been extremely interested in Dr. Dvorkovitz's paper; and there were one or two points to which he should like to refer. In the first place, he fancied that the great question which had been raised was that of Residuals *versus* No residuals. In the author's able defence of the residuals side of the question, he had, in calculating out the price of the products of the gas, taken benzol at 1s. 10d. per gallon; but he (the speaker) was under the impression that the price quoted the week before was 1s. 5d. per gallon. He could not help thinking that, if they were to use petroleum either obtained from the distillation of coal or Russian petroleum, and decompose it by a method which gave them 30 gallons of benzol per ton, the price of 1s. 5d. per gallon would very rapidly become beautifully less; and he was afraid that the balance of the account would very soon be upset. His own opinion was that, in the hundred years in which gas engineers had been working, their eyes had not been altogether closed, as Dr. Dvorkovitz seemed to imagine; and he could not help thinking that, even at the present moment, with the extra knowledge of chemistry which the gas engineer had at his disposal, he would rather perfect processes by which he would obtain gas, and nothing but gas, instead of having, his accounts and his working hampered by a large quantity, of uncertain items, which would vary from month to month, and from day to day in value. The author contended that they might look upon coal as carbon saturated with various paraffins, and that these afterwards split up into olefines by shedding off hydrogen. His own impression was they would find that, when they split up these paraffins by heat, they generally split themselves up into mixtures of very nearly equal proportions of the unsaturated and saturated hydrocarbons, and these at once commenced an enormous number of changes themselves—these changes being dependent upon the amount of heating surface to which, after their production, they had been exposed. If they took, for instance, ethane, and passed it through a red-hot tube, or took it as it came from the coal, and passed it into a red-hot retort, they would find it would break up into ethylene and hydrogen. When it was broken up in that way, they had gas, having precisely the same illuminating power as the ethane had when they started, but a double volume of it; so that they obtained twice the illuminating value of the ethane which they cracked in this way. The author had pointed out that the methods by which they cracked these oils had an enormous effect upon the products which they obtained. Now these products undoubtedly were, to a very great extent, produced at the expense of the gas which was got by cracking. When they took oil and cracked it, they obtained a large quantity of gaseous constituents; but when they hurried these out of the zone of heating, a very much higher illuminating power was realized than when they were passed through a long superheater. It was always a mystery to him why oil gas engineers insisted on "torturing" their gas after having obtained it. In order to make a fixed gas, the idea seemed to prevail that it was necessary to use so great a heating surface that the condensable vapours should all be converted into permanent gas. This was a fatal error, as in the attempt to do this, by far the most valuable illuminating constituents of the gas were broken down and degraded. What they wanted to do was to condense such vapours as quickly as possible, and not to try to convert them into a permanent gas in presence of the gas already made, because, if they did, they degraded and broke down the already formed unsaturated hydrocarbons, and, by doing so, reduced the illuminating power to a wicked extent. The author of the paper stated that they could not go farther in obtaining illuminating value by cracking the residues condensed from the oil gas; and by this it appeared that he meant that the total illuminating value to be obtained from such oil as he worked with was something under 900 candles per gallon. Now he (Professor Lewes) did not think Dr. Dvorkovitz could have meant that. He did not think he would say that the total illuminating value to be obtained from Russian oil was 900 candles, or a little under, per gallon. Mr. Glasgow, who introduced the Lowe plant into this country, stated that 1346 candles per gallon was obtained from the Russian distillate oil. Messrs. Goulden and Paddon afterwards modified this to a considerable extent, and brought the illuminating power down to something like 900 candles. This seemed to be about what Dr. Dvorkovitz had given them in the case where he cracked the oils; but, if he understood him aright, he used a method for cracking the oils by passing them through a large amount of heating tube surface—he allowed the oil to run from a funnel into a long heated tube, so that the gas first formed had to traverse a considerable heated surface. He believed this was what Dr. Dvorkovitz meant, because, in recently glancing through a specification of his patent, he saw that the essential feature of his method of gasifying oil was in making it, during its gasification, travel through a considerable length of heated tube; and it was in this way that they got this large quantity of benzol formed. The ethylene in the oil gas got broken down by the heated surface into various products—into paraffins, such as ethane and methane, with formation of acetylene; and this acetylene immediately polymerized up into benzenes. It was for this reason that they obtained this enormously higher quantity of benzol than they did by the other processes. He contended that this was a wrong method, as, although such bodies as benzol and naphthalene could not be cracked advantageously to yield illuminating gas, yet their production could be prevented; and he believed it could easily be proved that it was quite possible to get out of a gallon of oil, not 900 candles, but upwards of 1500 candles, or very nearly double the quantity which the author had given them as the result of his experiments. He knew of several processes—two processes at any rate—by which the result he had mentioned had been absolutely obtained. In gasifying oil by the processes he referred to, no liquid residues were formed—the only residue being coke; and he ventured to think that the gas manager would rather double the illuminating value and have no benzol, than have half the illuminating value and a quantity of benzol, which would be of varying value. He concluded by thanking Dr. Dvorkovitz for the very many interesting points raised in the paper.

Professor WATSON SMITH said he had listened to the paper with very great interest. On other occasions he had "broken a lance" in favour of British gas manufacturers. He did not agree that they were at the present time going wrong in the methods they adopted in the gasification of coal; they were too well controlled by the gas examiner and the tar distiller, and colour maker, for that. In order to make his point clear, he remarked that not only did coal oils and the oils obtained as residuals from the tar differ from coal, but coals themselves differed very essentially and, indeed, immensely one from the other. Let them take a hypothetical case. Supposing a chemist, new to the work, but with plenty of scientific learning and skill, was introduced into a gas-works, he would probably bring forward some such theory as they had heard that evening, as to the policy of adopting too high or too low temperatures. At one time in the Manchester Corporation Gas-Works, the class of coal to be carbonized was Wigan cannel. Now this cannel coal yielded an extremely rich illuminating gas; but, whether the temperature was a low or high one, the anthracene obtained from the tar produced, was almost valueless. Here then would at once arise a puzzling problem for the hypothetical chemist. If the temperature was a low one, the tar contained much paraffin, and the anthracene obtained from the tar was also contaminated with it; and on oxidizing with the bichromate mixture to produce anthraquinone in the manufacture of alizarine, the colour maker experienced great losses—the anthracene was ruined. If the temperature adopted was a high one, the amount of paraffin was truly diminished, but not sufficiently so to enable the colour maker to use the anthracene profitably. What did the gas manufacturer do? He found it was best to mix the cannel coal with certain proportions of less bituminous coals; and he (Professor Smith) considered such a classification was a scientific one, because the process had a "backbone" of good experience—an experience gained through the science of the tar distiller and the colour maker combined. But the results attained by the use of this mixture also showed at once how different the character of the coals forming that mixture were one from the other. And such was the case throughout. The old Boghead cannel, now extinct, was extremely rich in paraffin, or rather it was capable of producing a large proportion, larger than any other coal, of paraffin; whereas another coal, by carbonizing at a comparatively low gas-making temperature, would give a rich gas and excellent residuals. It seemed to him the author appeared to desire to legislate equally for Baku oil and for residuum, American petroleum and residuum, or coals and coal oils; but he (Professor Smith) considered that such argument was quite untenable. He might have misunderstood the author; and he should be pleased to be set right if so. These substances were very different. They might take sugar, naphthalene, a lump of pure anthracene, and a lump of paraffin wax. They looked, in the pure state, very similar white carbonaceous substances; but treat them in precisely the same manner, and under the same conditions in a closed vessel, at the same high or low gas-making temperature, and the results would be extremely different. The same would be the case if they treated in like manner Baku oil and residuals, or even American petroleum and residuals, and coals, coal oils, &c. The Germans might work very cleverly with German coals in gas making, and get excellent residuals; but let their retorts be charged with a rich British cannel once in a way, and he would predict a speedy confusion in their residuals department.

Mr. T. S. LACEY said he understood that Dr. Dvorkovitz recommended the production of gas from coal by two operations. By the first one, he obtained 20,000 candles to the ton and a residual. He then distilled the latter, and realized another 11,000 candles; the total result being 31,000 candles by

the two operations. But if he looked at one of his own tables, he would see that he obtained 32,000 candles simply by distilling coal in the ordinary way. If that was an improvement he recommended, it would not strike engineers as being worthy of much attention. He thought that Dr. Dvorkovitz had devoted a considerable amount of time and no doubt a great deal of ability in investigating the subject of the treatment of oil; but he must say that he did not think he had added anything to the information already possessed by gas engineers, and he could not say that the labour he had bestowed upon the distillation of coal was likely to do them any good. That was his opinion as a gas engineer. He should not like to say that he agreed with the table as to the cost of making coal gas. The cost of distilling a ton of coal was put at 13s.; and it was very curious that the cost of distilling a ton of oil was precisely the same. He did not know how these figures were arrived at in this way; but it was a peculiar coincidence; and it looked to him as if it were a slightly intentional one.

Professor W. FOSTER said the members were much obliged to Dr. Dvorkovitz for his paper. With regard to the remarks of the last speaker, he remembered that some twelve or fourteen years ago he applied to his (Mr. Lacey's) predecessor in office in connection with a certain matter upon which he was then engaged; and the answer he received was: "My good fellow, is it anything you are going to tell us we do not already know?" When a gentleman took upon himself to make investigations such as those they had before them, they might be of little value to the gas engineer; but, if they were made with honesty and good purpose, they deserved their thanks. He noticed that reference was made by the author to his (Professor Foster's) own work; but he was sorry there was not more appreciation of the table connecting the illuminating value with the total amount of carbon vapour present in the gas. His point was that there was always a connection, and a simple connection apparently, between the total amount of carbon vapour in an ordinary gas, made by the ordinary process of destructive distillation, and the illuminating value. If they took 100 volumes of London gas made by The Gaslight and Coke Company (which was always, so far as he knew, up to the standard), they would find about 58 per cent. of carbon dioxide; and it was remarkably free from nitrogen—never more than 1½ per cent. Now this 58 per cent. of carbon dioxide ran in connection with certain lighting value; and when they had gas giving, on combustion, 63 per cent. of carbon dioxide, the lighting value went up. This method of attacking a difficult problem was one on which Dr. Edward Frankland spent a great deal of time, and was to his mind a very satisfactory way of doing it—leaving out the heavy hydrocarbons, and taking them *in toto*; and it averaged fairly well gas made from ordinary coal in the ordinary way, without allowing air to get into the retort by excessive exhaust. With regard to the quantity of gas obtained per ton of coal, he asked how the author accounted for the production in one case of only 5000 cubic feet per ton, and in another of 4500 cubic feet; while gas engineers generally took the average yield at 10,000 cubic feet. Through this he did not understand the import of several features of the paper.

Mr. BOVERTON REDWOOD said it appeared to him that one of the most interesting features of the paper had been overlooked by those who had already taken part in the discussion. He referred to the suggestion that the most satisfactory results, from a gas maker's point of view, were to be obtained by the employment of the heaviest of the oils with which Dr. Dvorkovitz operated. He understood him to say that he preferred to use, for the purpose of manufacturing gas of high illuminating value and the residuals, an oil of higher specific gravity than most of those who had worked at the subject of the gasification of oils had found it advantageous to use. He thought it was possible that the necessity he appeared to have found for the employment of what Professor Lewes had pointed out—a rather large amount of heating surface to effect the conversion of these liquid hydrocarbons into a permanent gas, might have some connection with his preferred use of an oil of that description. Personally his experience (which was not very recent and not very extended) had led him to believe that the best results might be obtained, not by the district employment of an oil of that description—a comparatively heavy oil—but rather by the adoption, if it were necessary to make use of an oil of that kind, of some intermediate process for its conversion into liquid hydrocarbons of less density, which were very amenable to treatment in the final process of gasification. Knowing as he did that Dr. Dvorkovitz had devoted some considerable attention to this subject, and that he would not put forward a statement of that sort without having some sufficient grounds for bringing it under the notice of the members, he regarded it as a very important feature of that section of the paper. Obviously the effect of a paper of this sort lent support to the contention that much of the work that had been carried out in recent years in connection with the manufacture of oil gas had been done unscientifically and unsystematically; but he certainly felt a great deal of sympathy with those who had pointed out that their thanks were due to gentlemen who had come forward in an unassuming manner, and were willing to lay before the members for their consideration, a series of experiments of this kind. On the present occasion, he took it that Dr. Dvorkovitz did not dogmatize; but he came before them in a very proper spirit, and said he had obtained results which he believed had a certain value in connection with this highly interesting question, and in the hope that he might be making some useful contribution to their knowledge on the subject. It did seem to him, therefore, that their thanks were due to him for the contribution he had placed before them.

Mr. A. MACKINNON observed that, in December last, he presented to the Institution of Civil Engineers a long paper on the subject of oil and coal gas and carburettors. He had given a good deal of attention to the carburetting of gas. For some forty years he was the engineer of an oil-gas works, where they employed Mare's oil; and a very fine quality of gas it gave—it was almost pure and refined gas. In his paper he urged gas engineers to endeavour to improve the quality of coal gas by the addition of a gas made from oil. There were a great many oils that could be employed. They were very abundant just now; and he did not see why they should not be adopted on a large scale. Dr. Dvorkovitz had criticized the existing process of making gas from coal; but he (the speaker) was afraid there was no remedy, and high heats must be continued. The fact that the author of the paper had a large make of coke showed that he had employed a low heat. With a low heat, they obtained a large quantity of coke of a superior quality, and the gas was also of a superior quality. But the process would not pay; and therefore it seemed to him that the only way of getting over the difficulty was to make up for the deficiency of the illuminating power of the gas by mixing (he proposed in his paper) one-third of gas made from oil. He named a number of oils in the paper, including "Stellar" oil. In gas made from oil, if a high heat were employed, they would split up the most valuable illuminating gas, which was ethylene; and therefore a low heat must be used.

Mr. SUTHERLAND inquired if Dr. Dvorkovitz had experimented with lignites for the manufacture of gas. Not long ago, he tested a lignite which gave a very good yield of gas; and, at a comparatively low temperature, there was a large quantity of oil, about 30 to 40 gallons per ton. With regard to the conversion of oil into gas, allusion had been made to the production of 900 candles per gallon. He was not at liberty to refer to the process upon which he was working; but he might say, with respect to the conversion of Russian oil into gas, he had been connected with certain experiments in which they obtained some 1200 candles per gallon, which was not an uncommon experience in gas-works. There was only one other point—that was the question of sulphur. Dr. Dvorkovitz said he had obtained coke containing only a trace of sulphur. This was very important; and he should like to know whether he hoped to produce coke for metallurgical purposes absolutely free from sulphur.

Dr. DVORKOVITZ, in reply, said that Professor Lewes had made some remarks with reference to the candle power per gallon of oil. The illuminating value which he obtained was only about 832 candles. Certainly, as he had pointed out in his paper, the only way to make the use of oil for enriching or carburetting gas a commercial success in England was by trying to get bye-products; and what he had tried to do was to cheapen the price of oil by obtaining very valuable products. He thought he was right in saying that, in using Russian oil for the purpose of gasification, they must treat it gently, and not crack it altogether. He had not touched upon the question of his patent in the paper; but he was much obliged to Professor Lewes for having mentioned it. As to the remarks of Professor Smith, this question of the gasification of coal was an important one for gas engineers. From the German tars was obtained a much larger yield of benzol than from English tars, because the German gas engineer worked hand in hand with the chemist. The English gas engineer tried to get a large yield of gas per ton; but it would be much better for him to obtain a less quantity of a higher quality of gas. It was very well known that the German engineer never went beyond 8000 cubic feet per ton of coal; while the English engineer went to 10,000 and 11,000 feet, and even higher. He maintained that this was radically wrong; and that, by such working, they could never obtain good practical results. Respecting the remarks of Mr. Lacey, he was aware that in English gas-works they were trying to burn off the whole of the bye-products, and obtain a large yield of gas. His figures were correct; the seeming discrepancy being explained by the fact that in his experiments he was using ordinary household coal. The figures quoted by Mr. Foster were also correct. It would be seen that he gasified at a low temperature, and obtained only 5000 cubic feet of gas, but it was of from 17 to 22 candle power, and this from ordinary coal—not gas coal. He was astonished to find what a little attention was paid to the chemist in gas-works in this country; and, regarding the observations of Mr. Sutherland, he said he had a sample of coke, obtained by his process, quite free from sulphur.

A vote of thanks was passed to Dr. Dvorkovitz for his paper.

Appointments.—Mr. J. Gibson, who for the last two years has been assistant at the Paisley Corporation Gas-Works, has just been appointed Manager of the Corporation Gas-Works at Beverley, in Yorkshire. There were 116 applicants for the post. Mr. John Dewar, son of Mr. D. Dewar, Chief Constable of Dundee, has been appointed chief assistant to Mr. G. R. Hislop in the Paisley Gas-Works. Mr. Dewar has for some years been junior assistant to Mr. John M'Crae at Dundee.

CONSTANT DISTRICT PRESSURE AUTOMATICALLY MAINTAINED.

Last year several patents were applied for in the English office and abroad to simplify, and render more certain, the action of district pressure governors; and no one in this connection has a greater claim to recognition than Mr. William Cowan, of Edinburgh. Those of our readers who have watched the working of Mr. Cowan's "Automatic Pressure Changer" will not need telling of the amount of study he has given to this particular subject, and the mechanical skill he is able to bring to bear on any task of the kind which he takes in hand. The following account of the latest of his completed inventions, written by Mr. Cowan himself, will therefore be read with very general interest:—

The valve of a gas-governor is suspended in equilibrium, so that it may respond automatically to variations of density in the main and to changes of load on the bell. The necessity for altering the load at all arises from the inadequacy of the carrying capacity of the mains. If these were in all cases large enough to convey the maximum quantity of gas to the remote parts of the district at such a pressure as would suffice for the minimum demand, no change of load would ever become necessary. In such (ideal) circumstances, the mains would be in harmony with the governor, and with the necessities of the district; while the valve would open as freely in response to the largest demand, as it would certainly reduce its opening when the demand diminished. But these are not the ordinary conditions of gas supply; nor is it at all probable that they will ever become so. The mains are always inadequate to convey the necessary quantity during the period of greatest consumption, without an increased load being applied to the governor. It is invariably necessary, during such periods, to produce an augmentation of density in the bell and in the main. The mains are too small in bore, as well as too great in length, to convey the necessary volume at the pressure which, though sufficing for a small demand, is quite inadequate to meet a large one. The loading and unloading of governors are, therefore, operations which are necessitated by the insufficient carrying capacity of the mains; and it would be superfluous to point out the permanent character of that condition, and of the consequences that flow from it.

But, although loading and unloading are thus indispensable,

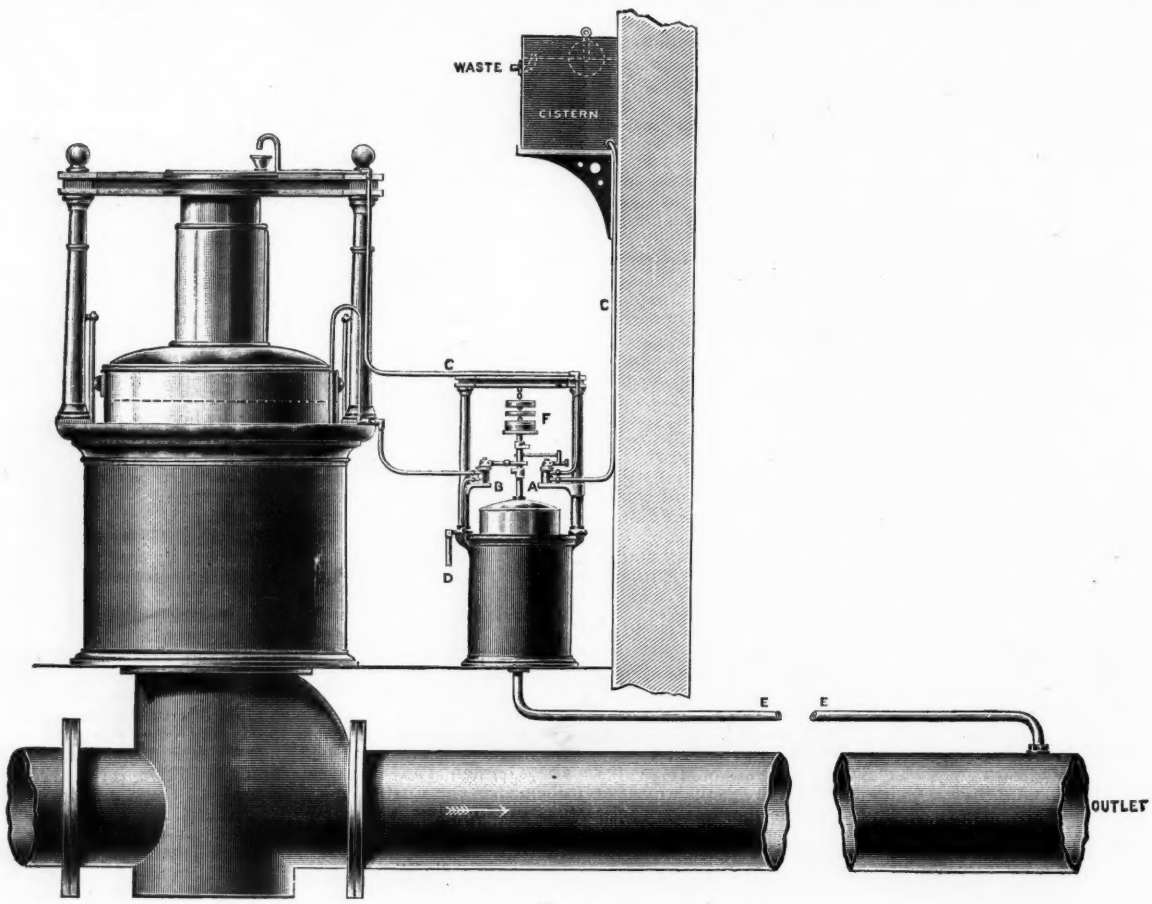


FIG. 1.

care is required in their application. No system of loading should be employed which to any extent deprives the governor of its normal and automatic action; for a governor ought to be free, under all circumstances, to maintain the adjusted pressure so long as the latter can be maintained by an augmentation of volume without an increase of pressure. It is here that all those systems fail which make the load on the bell depend upon the bell's position and the amount of the valve opening which that position gives. A governor bell should be permitted to open the valve as far as it will open it, and to reduce the opening as much as it will reduce it, before any change in the load and pressure is made. While it is true that, *beyond a certain point*, "increased demand requires increased pressure," it is not true that every augmentation of demand should be met by augmented pressure. If the latter statement were correct, the governor, loaded in accordance therewith, would cease to act as a maintainer of pressure irrespective of volume, and would become a mere changer of pressure of a most objectionable kind. The power of such a governor to pass varying quantities of gas at any fixed pressure would be abolished; while the bell and the valve would become the sport of every change in the demand which occurred in the district.

Notwithstanding these obvious considerations, many attempts have, from time to time, been made, in this and other countries, to load the bell more or less in accordance with the above principle. It may therefore not be out of place to quote here some remarks by the present writer, the substance of which appeared in the JOURNAL on a former occasion:—

> It has been proposed and attempted to make gas-governors capable of loading and unloading themselves, and so, in response and in proportion to the demands of a district, to vary the pressure they give. In applying such a system, the plan has been tried of causing the bell, as it falls in response to an increased demand for gas, to begin at a certain point in its descent to take on, gradually and automatically, a load of water or other liquid, and to go on accumulating the same during the rest of its downward movement. The extra load and pressure thus received would, if in excess of the demand at the time, cause the bell to rise, and in so doing to gradually lose the extra load it had taken on. In this way the pressure has been raised above, and then restored to the minimum, in consequence of the falling and rising of the bell. To such an application of the principle of self-loading, there is the fundamental objection that it unnecessarily and undesirably interferes with the degree of pressure which may be sufficient at the time. After the valve has opened to the point at which the self-loading begins, an increase in the number of lights anywhere in the district produces an increase in the pressure everywhere. A demand which might be met by a mere increase of volume is supplied at an increased pressure; and this increase of pressure may be entirely unnecessary. The area of the valve opening cannot be

enlarged without the pressure being at the same time augmented. In like manner, a decrease in the demand, which would be most properly met by a diminished volume, is also attended by a decrease of pressure. The combined effect of the two (one being unnecessary) may lead to a too sudden reversal of the bell's movement, and therefore to a sudden increase of both pressure and volume; and so a sort of "see-saw" action may be set up because a varying demand has been met in an undesirable way.

It is no doubt true that, in many cases, the size of the mains is so inadequate, that the governor-valve does not, at the minimum or day pressure, open to a greater extent than from one-half to two-thirds of its area. This, of course, renders the remaining half or one-third, as the case may be, inoperative, so far as the ordinary automatic action, at the minimum pressure, is concerned. The gas in the main, retarded by an excess of friction, acts as a "cushion," against which the moderate load on the bell cannot prevail to increase the valve-opening. In such a case, an augmentation of volume by an enlargement of the valve-area, is unattainable, because the main is incapable of passing more gas at the pressure the bell is loaded to give. But, while this is quite correct, it is no reason for depriving the *effective* portion of the valve of that self-regulating function which is the proper duty of every governor. It may be taken as proved that *a governor should not be its own loading and unloading agent;* and the probability is, that all attempts to make it act in that capacity, will not be attended with more satisfactory results than those which have accompanied past efforts in the same direction. The invention which it is the object of the present article to introduce, proceeds on an entirely different principle from that of the systems above referred to. Before adding a brief description of the new system, it will be desirable to indicate the *principle* on which it is based.

The loading and unloading of gas-governors by means of the "Automatic Pressure Changer," invented in 1878, were both made dependent on the combined agency of a clock and the gas pressure; the pressure employed being that in, or close to, the governor outlet. In the present invention, the use of a clock is dispensed with, and the gas pressure alone is employed; because, in this case, the load is not varied at certain times, but only to meet changes in the demand for gas, quite irrespective of when or how these may arise. But, in order to make this possible, the pressure which regulates the loading must be the pressure in some part of the main more or less considerably distant from the governor that supplies it. It would, of course, be futile to attempt to regulate the amount of load by means of the pressure in or adjacent to the governor outlet, because the pressure there depends so exclusively on the amount of load, that no change of pressure can, in an efficient

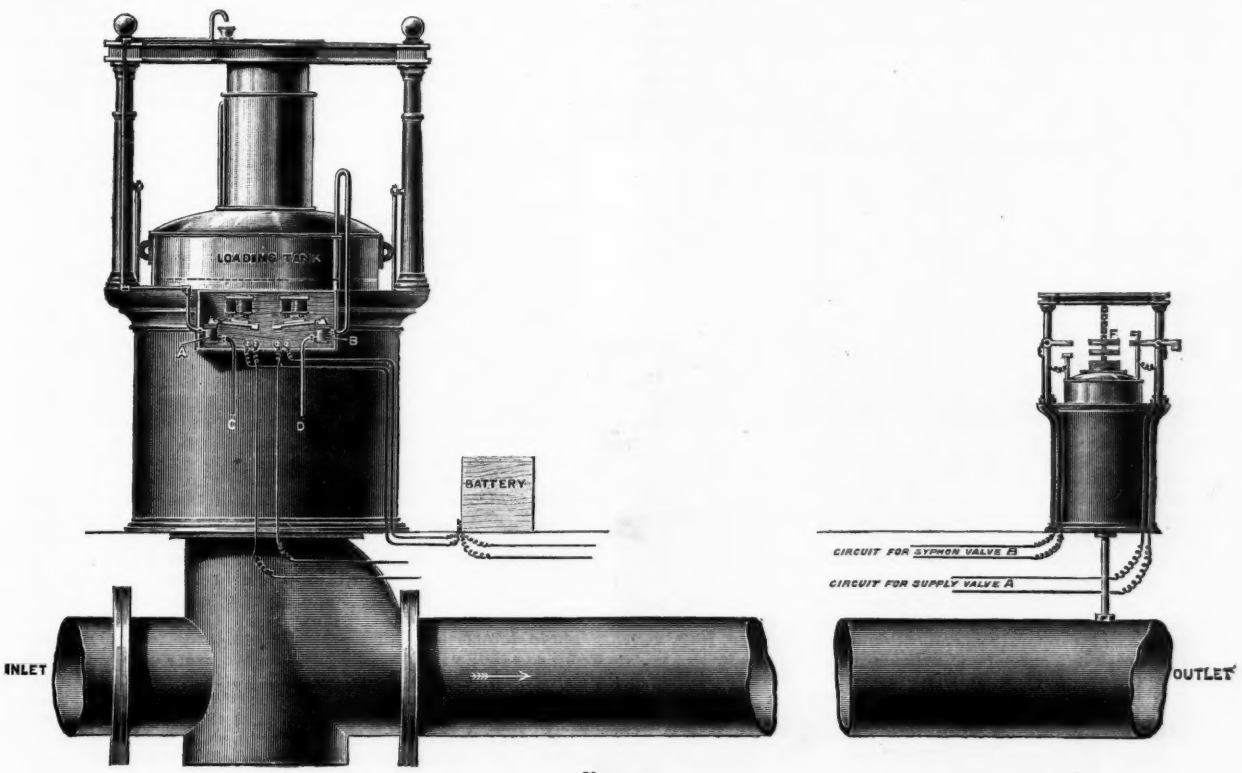


FIG. 2.

A. Supply valve (Figs. 1 and 2).
B. Syphon discharge valve (Figs. 1 and 2).
C. Supply pipe from cistern (Figs. 1 and 2).
D. Syphon discharge pipe (Figs. 1 and 2).
E E. Pressure return pipe (Fig. 1).
F. Suspended weights (Figs. 1 and 2).

governor, precede a change of load. It is otherwise, however, at a point remote from the governor, where friction has so retarded the passage of the increased supply which an enlarged demand requires, that the pressure may thereby fall in the district, while it is maintained, undisturbed at the governor.

In like manner, though the pressure at the outlet of a thoroughly efficient governor cannot increase without a change of load, it yet may rise, in a remote district, from the lower degree to which a large demand may reduce it, to the higher degree which a reduction in that demand may allow it to attain. For example, a governor may be loaded so as to give a certain pressure at its outlet, with the view of producing a required pressure in the district it supplies; but the pressure in that district may be reduced more or less considerably as consumption increases, by the combined influence of friction and large demand. But as the demand lessens, and the friction diminishes, the district pressure will rise, and approximate more and more nearly to the pressure at the governor outlet. By utilizing these fluctuations, it becomes practicable to regulate the load automatically by means of the pressure in the remote district, and in proportion to the demand for gas.

It is on the above facts that the principle applied in the present invention rests; and the various modifications of the system have the same common basis. The principle itself may be fitly stated in the words of the first claim, which is for "automatically regulating the loading and unloading of gas-governors by the pressure of gas in the main of a district remote from the governor." Keeping in view the above definition of the principle, a brief description, in addition to the accompanying illustrations, will show clearly to the reader how that principle is applied.

No special form of governor is necessary for the purposes of this invention, because all changes of pressure, from whatever cause arising, are instantly dealt with by the loading and unloading operations of the auxiliary gasholder. Hence, although it is always desirable to employ the best form of governor, the fact that such a governor is not available in any particular case need not prevent the application of the present invention. The governor shown in the illustrations corresponds with many which are in extensive use both at home and abroad; and it possesses the advantage of a water-loading arrangement perfectly adapted for the immediate application thereto of the present invention. Another point of importance is that, with this form of governor, any temporary interruption or suspension of communication from a remote district would not be attended with any inconvenience, because the governor

would perform its functions perfectly without having to depend upon the corrective operations of the auxiliary gasholder.

In adding the new system, the water supply and discharge pipes of the loading-tank are connected to the corresponding valves A and B on the auxiliary gasholder, the bell of which opens the supply-valve in falling below, and the discharge-valve in rising above, the normal position in which both valves remain closed. The gasholder bell is itself operated by the pressure of the gas in a district more or less considerably remote from the governor. When the gasholder occupies a position near to the governor, as in fig. 1, the pressure from the distant main is transmitted through the return-pipe E. In this case, the bell actuates the valves mechanically and directly. But when no return-pipe is employed, and the gasholder is removed to the remote district, and connected with the main there by a short length of pipe, as shown in fig. 2, the valves are in that case fixed on, or near to, the governor. In this case, the valves are operated electrically, and indirectly by the falling and rising of the distant gasholder, the movements of which cause electric circuits to be completed or interrupted, and thereby to operate the electro-magnets which open and close the valves.

In order to limit and regulate the falling and rising of the gasholder bell, the weights F are suspended in such a position that as the bell falls, in consequence of a reduction of pressure, weights in proportion to the reduction are left off; and, in like manner, during a rise of the bell, caused by an increase of pressure, weights are taken on. But for this arrangement, the bell would either fall to the bottom or rise to the top whenever the pressure fell or rose. The rising and falling of the bell in response to pressure is, in the first instance, determined by the bell's own weight, which may be varied according to circumstances; but it is also further regulated by the suspended weights coming into and going out of operation in the manner above referred to.

The reduction of the pressure in the remote part of the district with which the auxiliary gasholder is connected will, by bringing down the gasholder bell, open the supply valve through which the water passes to load the governor. By this means, the falling pressure in the remote district will be almost immediately restored to the normal point by the governor receiving an extra load. The flow of water into the loading-tank will cease when the gasholder rises, in response to the increased pressure, and closes the valve which had been opened. In like manner, any tendency to an increase of pressure beyond the normal point will be frustrated by the rising of the gasholder bell in response thereto, and the opening of the discharge-valve, which, by reducing the load, prevents any increase of pressure.

So far as the *principle* is concerned, it is a matter of no moment whether the return pressure pipe or the electric conductor system is employed as the means of communication between the remote district and the loading-valves. Whichever system may be adopted, the result will be the same. It is simply a matter of convenience, and cost; and these may be easily calculated.

A further development of the same invention, applicable to certain exceptional circumstances and conditions, which forms the subject of a separate specification, dated Nov. 16, 1892, will be dealt with in a subsequent article.

INCLINED RETORTS AT LEIGH (LANCS.) GAS-WORKS.

[Communicated.]

At these works, the present retort-house is 54 feet span; and it was originally built and arranged for horizontal retorts 17 feet long, with one row of settings. During the year 1891, owing to the increased consumption of gas, it was absolutely necessary to enlarge the carbonizing plant; but it was found that, if the old system were adhered to, additional land would have to be obtained for the new retort-house. Mr. Alfred T. Fletcher, the Engineer and Manager, however, decided to erect the inclined retort system in half of the existing house, and in this way provide for a daily carbonization of 84 tons of coal, as against 28 tons on the horizontal method on the same area. The house was re-arranged so that two rows of inclined settings, measuring 10 ft. 4 in. in breadth on the horizontal line, and 70 feet in length over all were erected. The breadth of the charging-floors, which are on the outside, are 8 ft. 8 in.; and large openings are provided in the retort-house wall for ventilation. The drawing stage is between the beds. It is formed of concrete, with a good facing of stone flags and blue bricks. This forms the roof of the furnace subway. The arrangement of ventilation of the cellar is effective; and from the subway there runs an underground passage rising gradually to the level of the coke yard.

In carrying out the excavations for the subway, considerable difficulties were met with. The existing tar, liquor, and gas pipes had to be re-arranged without stopping the make of gas; and in the operation water was encountered at a depth of 4 feet from the surface, which necessitated special drainage arrangements being made. The existing plant consists of a bench of seven settings, with seven retorts per bed; the length being 12 feet, and the section 21 in. by 15 in. ⊏, set at angles of 31°, 31½°, and 32°.

A few words will suffice to describe the erection, construction, and working of this installation. The retorts are heated by a new form of generator furnace and setting, designed by Mr. Fletcher, which was specially constructed to overcome the difficulties hitherto experienced. This furnace gives every satisfaction. The heats are good, and evenly distributed over the whole length of the retorts; and a compact arrangement of dampers greatly adds to the facilities of working. Although regeneration is not attempted in these furnaces, the fuel account is economical—ranging from 14 lbs. to 18 lbs. of coke per 100 lbs. of coal carbonized, according to the quality of the fuel used. The retorts are placed three on the top tier, and two on the middle and lower tiers. This allows for a good size combustion chamber. The coke slides out of the retorts, and is conducted directly into the deep producer underneath, by means of a shoot. The whole of the brickwork is well bound together by means of 10 in. by 5 in. H-iron buck-stays, and 2-inch diameter tie-rods, with the necessary adjustable screws, &c. The top mouthpieces are 18 inches deep, 21 in. by 15 in. ⊏ section, provided with Ruscoe's patent lids and fasteners. This allows ample space between the 7-inch diameter ascension-pipes and the face of the settings to keep the pipe cool. It may be mentioned that no trouble has been experienced with stopped pipes; and Mr. Fletcher is satisfied that no reason exists why stopped pipes should be more common to inclined retorts than with horizontal ones. The bottom mouthpieces are only 9 inches deep, fitted with the same patent lid. The whole front of the bench thus presents a clean appearance. Suitable cross-stays are fixed to support the mouthpieces. The hydraulic main is supported on the transverse H-iron tie-rods (and by this means is kept away from the hot brickwork), and is fitted with a constant slow feed and liquor overflow.

The coal is brought into the works by carts, and shot into the coal-store, which runs parallel with the retort-house. In the centre of the floor, the coal-breaker is fixed. A receiver is fitted over the breaker, into which the coal is tipped direct; and it passes into the elevator, which in turn raises it to the roof. The coal slides therefrom to an adjustable shoot, which conducts it to the trough of the steel chain push-plate conveyor. The coal is carried by the conveyors and distributed to 21 small hoppers 2 ft. 6 in. by 1 ft. 6 in. by 3 ft. deep made of ¼-in. wrought-iron plate, each large enough to hold one charge. At the bottom of these hoppers, sliding doors are fitted—actuated by levers arranged along the side of the wall, and within easy reach of the attendant. Underneath these small measuring tanks, the moveable and adjustable shoots run upon rails; and by this means the coal is spread upon the floor of the retort.

The different mechanical arrangements of the shoots are easily set by the attendant; and they have proved very effective. This has been tested by taking any variety of coal indiscriminately from no less than six different classes used. The necessary wrought-iron stops, &c., are employed to prevent the charge sliding into the bottom of the mouthpiece; and a wrought-iron flat plate is fixed under the mouthpiece, to prevent the coke falling upon the lid and fastener. The coke is at present drawn upon the stage floor, quenched, and carried to the yard in barrows.

These retorts were at work independently for over three months of the past season; and this gave every opportunity of checking the illuminating power, which was proved to be up to the required standard. In the quantity and quality of tar per ton of coal carbonized, it is found that there is no difference on the year's working. Although there were one or two slight hitches at the starting of the plant, everything was remedied as speedily as possible until, we learn, the plant now works very smoothly and satisfactorily.

As a result of the working of the inclined retorts, together with the absolute necessity to increase the carbonizing plant for the coming season, Mr. Fletcher has decided to duplicate the retorts and plant, and erect a further seven beds of inclined retorts on the other side of the house. Large overhead coal storeage hoppers will be fixed; so that a full night's storeage of coal will be provided, and save the necessity of running the machinery except during the day. The plans for the extension show the roof raised 10 feet, making a total height for the retort-house of 31 feet over-all. There will be about 6 feet of new brickwork; and the remainder will be made up of wrought-iron latticed work. By this, Mr. Fletcher contemplates having plenty of ventilation in the house.

A cross conveyor receives the coal from the existing elevator, and feeds the new longitudinal conveyor to be fixed over the main hoppers, and thereby supply the whole of the retorts.

When the house is completed, the coke will be drawn and quenched by special arrangements in the subway; then elevated mechanically, and carried by a tilting bucket steel-chain elevator, and conveyor, and deposited into three large hoppers, 12 ft. by 9 ft. by 9 ft., with screw-valves and hand-wheels in the bottom. By this means, the carts which are constantly travelling to the railway siding can be readily filled with coke. This conveyor is continued a distance of 130 feet beyond the coke-hoppers, and is arranged to effect the automatic handling and storeage of coke over the yard.

Great credit is due to Mr. Fletcher for the complete manner in which he has planned out the erection and working of the inclined retorts; and it will be clear that, when the extensions indicated are finished, the works will rank among the best

equipped with automatic appliances in the country, and the Leigh Local Board cannot but reap the benefit of their Engineer's foresight.

It may be mentioned that the contractors were Messrs. Jonas Drake and Sons, of Halifax, for the brickwork and superstructure; while the New Conveyor Company, Limited, of London, supplied and erected the elevators, conveyors, hoppers, &c. Mr. Maurice Graham, Assoc.M.Inst.C.E., advised, as occasion required, for the Automatic Coal-Gas Retort Company, Limited, the owners of the patent rights.

REGISTER OF PATENTS.

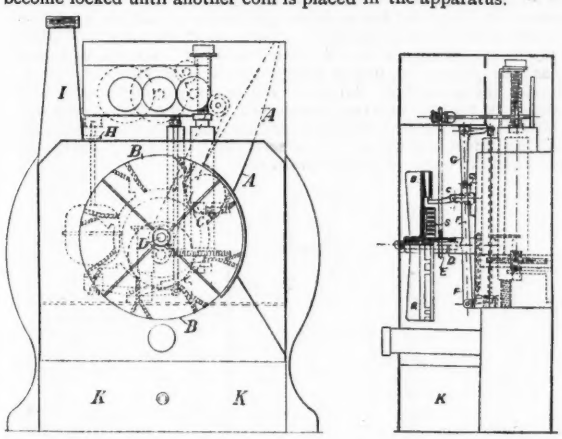
Gas-Engines.—Dawson, H. T., of Salcombe, Devon. No. 6952; April 11, 1892.

This invention relates in part to improvements in gas-engines having pistons which rotate within the working cylinder, and serve as valves to control the admission of gas and air to the cylinder, the ignition of the charge therein, and the expulsion therefrom of the products of combustion. Such engines are described in patents No. 6407 of 1890 and No. 9865 of 1891. The invention relates in part also to gas-engines in which the piston does not rotate within the working chamber, and separate valves control the admission, ignition, and expulsion of the charge and its products.

With an engine in which the piston has a reciprocating movement, giving motion to the crank without itself rotating, and in which separate valves are provided for the admission, ignition, and exit, it is needful for it to be of the four-cycle type—that is to say, it takes its charge during the outstroke of the piston; it compresses the charge during the instroke; while the ignition takes place at the commencement of the next outstroke. After the effective stroke, and during the next instroke, the products of combustion are expelled. The patentee prefers to arrange the engine with the cylinder inverted and vertically over the crank; but these arrangements are not essential. There is a combustion chamber upon the outer end of the cylinder; and it is arranged for the valves to open into this combustion chamber. The valves are controlled by an eccentric and a cam upon a shaft parallel to the cylinder, which rotates once during the cycle of the engine. In connection with this axis also, a governor is provided, for regulating the speed by controlling the gas admission.

Prepayment Meters.—Beechey, C. G., of Stoneycroft, Lancs. No. 8428; May 4, 1892.

This invention has reference to gas-meters in which the act of putting in a coin or the like will allow a given quantity of gas to pass, and which, after such a volume of gas has been passed, will automatically become locked until another coin is placed in the apparatus.



The illustration shows the improvements applied to a wet meter.

A is a tube or conduit, adapted to receive and convey the coins to the mechanism; a slot being provided in the top of the meter through which they are inserted. B is a wheel with pockets on its periphery, adapted to receive the coins, and by which the automatic mechanism is freed. C is a hinged detent having a counterbalance, by which the wheel B is held and freed or released. D is a worm or threaded shaft, worked from the meter, as hereafter described; the ends of it being mounted and held in the meter in suitable brackets. There is a screwed boss on the wheel B, serving as a screwed nut, and adapted to move the worm-shaft D longitudinally—viz., in cutting off the gas in one direction when the wheel is rotated. E is a sleeve working on the worm-shaft D, with a key working in a corresponding keyway in the sleeve. There is a driving sprocket wheel on the sleeve. F is a lever, on the middle part of which one end of the shaft D abuts; while the upper end is connected to the gas-controlling valve through the crank G, with its levers and float-rod. H is the gas inlet-valve—the ordinary gas admission-valve of a wet meter, controlled by a float. S is the power accumulating spring (a helical one), one end of which is connected to the sleeve E, and the other to the flange on the wheel B. I is the ordinary gas inlet-conduit. The sleeve E is driven by the sprocket wheel and chain J, actuating the lower part of the existing spindle of the unit wheel of an ordinary wet meter. The coin or token wheel B has its pockets arranged in the same plane as the wheel; and the coin or token conduit A has a twist in it of 90°.

The operation of the apparatus is as follows: Assume the spring S to be wound up, and have power so accumulated in it. Then, upon the insertion of a coin in the slot—the detent C having its active end at the point shown in fig. 1 engaged with and holding the wheel B by the corner piece of metal—it falls from the conduit A into one of the pockets (which are always co-incident with, or directly under, the conduit A, when the payment is not being made), and strikes and rests upon the free end of the detent lever C, freeing it. In this condition, the accumulated power of the spring acting upon the wheel, causes it to make a partial revolution. The boss will thus be revolved to a similar extent; and it will thereby have moved the worm-shaft D longitudinally thereon, and away from the lever F—thus allowing the float to be lifted by the water in the meter, and the gas-valve H to open. After the pocket charged with a coin leaves the detent C, the latter is lifted by its counterbalance weight into such a position that, when the next pocket comes up to it, the next part thereof will strike it; and the wheel B will be stopped and held, and cannot move until the insertion of another coin in the slot. When the pockets have passed the shield, they fall out by gravity into the drawer K.

When gas is consumed, after the "setting" of the meter by the action of the boss of the wheel B on the screwed worm D, the latter comes in contact with the lever F, and presses it back. This action, through the bell-crank lever G, and its rod, closes the ordinary existing float-actuated valve H of the meter, by pulling down the rod thereof, and the float, when all the gas for which prepayment has been made has been consumed. In setting the meter to give a supply of gas, of course, the reverse action takes place; and through the levers and parts just specified, the float is allowed to lift, and the meter so becomes "set" to allow gas to pass through it.

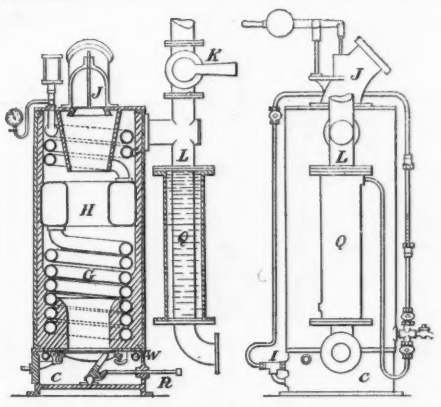
By this construction, it is provided that the apparatus would be capable of receiving a number of coins one after the other, each of which will release the wheel B, which will thereupon be rotated by the spring S, and will thereby move the shaft D outwards a certain part of its possible stroke, and allow the gas-valve to open to a given extent. When the limit of outward longitudinal movement of the sleeve E is reached, no more coins inserted in the meter will effect the operation thereof.

A meter having been "set"—that is, its gas-valve opened by the insertion of coins—gas may be passed through the meter aad burned. When this is done directly consumption takes place, and the meter begins to move, the spindle commences to rotate, and the worm-shaft works back horizontally through the boss of the wheel B. Simultaneously therewith, the spring S begins to coil up, and so again accumulate power; the rotation of the boss itself in this action being prevented by the wheel being held. When this longitudinal movement reaches the point from which the shaft D started, from the first insertion of the coin, the valve H will have become closed, and no more gas can pass, and the meter stops; and the exact amount of gas for which prepayment has been made by the coins inserted, will have passed through the meter.

The mechanism therefore provides an automatic supply and cut off, whereby, on the one hand, by the insertion of a coin, power accumulated in a spring is free to act, and operates and "sets" the meter to give an equivalent supply of gas to the coin; and, on the other hand, by the consumption of the gas so paid for, this mechanism is worked back by the meter as the gas is consumed, and brings it back to the point at which it started, thereby shutting off the gas and stopping the meter, and winding up, and storing or accumulating power in so doing.

Gas Manufacture.—Rogers, H. J., of Watford. No. 8892; May 11, 1892.

The object of this invention is to construct a gas producer "in a more concentrated form than has been hitherto the practice; and thus to simplify the process of gas making, and to lessen the cost of the apparatus used therefor."



The producer is made with an outer shell of iron, lined on the inside with fire-clay or other refractory material, and having for its base an ash-pit C, with a door that can be hermetically sealed. The grate-bars (cast in one or more pieces) are hung upon bearers in any convenient manner. Embedded in the refractory lining is a coil of pipes, the lower part of which contains water, and the upper part steam. In the case of more than one coil, steam is generated in one coil and superheated in another; and a steam chamber H is fixed between the water and steam coils. The steam is led from these coils through the ash-pit and under the grate-bars, by means of an injector I, which draws in atmospheric air, and forces both air and steam through the incandescent fuel in the producer. If it is desired to produce illuminating gas, oil is also injected with the air and steam.

The usual arrangements J are provided at the top of the producer for admitting the fuel; for the exit K of the products of combustion, when gas is not being produced; and for the passage L of gas to a condenser Q.

In some cases one of the coils is dispensed with, and a tubular or other boiler is fitted above the refractory material in the producer. Steam is led therefrom to a coil embedded in the refractory material,

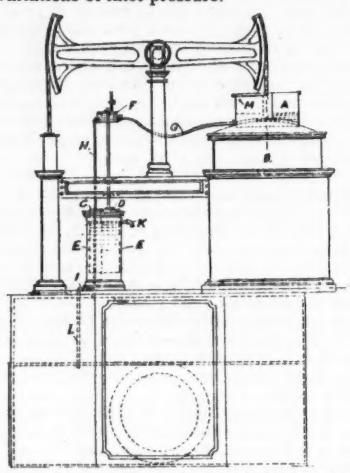
for the purpose of superheating it, before passing it through the injector to the incandescent fuel; and in order that the boiler may be easily removed when required, there is a lute on the outside of the casing and a corresponding projection on the angle flange of the boiler, filled with asbestos or other suitable material for making a joint.

The condenser Q is also made in a more concentrated form, by passing the gas through a pipe immersed in a column of feed water; the water cooling the gas on its way to the holder, and the gas, in its turn, heating the water on its way to the coil or boiler inside the producer. The air may be warmed before injection, by passing it through a coil W.

If it is preferred to clinker the furnace-bars without opening the furnace-door, this can be done by means of a handle R, working in a slot in a lever pivotted on a fulcrum; the long arms of the lever passing through the fire-bars, and thus clearing the clinkers away between them —there being as many arms as spaces between the bars.

Gas-Governors.—Hawkyard, J., of Saddleworth, Yorks., and Braddock, J., of Oldham. No. 10,947; June 10, 1872.

The object of this invention is to produce a station gas-governor that will automatically give an increased outlet pressure whenever the demand for gas increases, and a diminished outlet pressure as the demand for gas falls—such increase or decrease being constant, notwithstanding variations of inlet pressure.



The illustrations show the invention applied to a station governor, constructed according to patent No. 16,065 of 1890.

The loading tank A is fixed upon the crown of the governor-bell B. It contains water, the supply and overflow of which increases automatically as the demand for gas increases, and decreases as the demand falls. In order to compensate for the effect of a varying inlet pressure, which would alter the position of the valve for the same quantity of gas passing through the governor, a bell C is employed; and the float D works in a tank E, containing a liquid, and varying in height, to any desired degree, with the variation of the inlet pressure.

On the top of the bell and float is a filling and overflow vessel F, connected to the loading tank by a flexible pipe G, so that the level of the liquid will be the same in both the filling and overflow vessel F and the loading or pressure-changing tank A. A constant supply of water may be given to the vessel F, which is provided with an overflow-tube H or nozzle, to carry off surplus liquid.

When the governor is loaded to give the maximum outlet pressure required, and the valve is correspondingly open, the level of the liquid in the loading-tank will be at its highest point requisite to give such pressure; and, as the inlet pressure increases from any cause, the tendency of the governor-bell B is to rise, and partially close the valve. This throws off some of the liquid from the loading-tank into the filling or overflow vessel F, and reduces the outlet pressure. But the bell C attached to the float D, and subjected to the inlet pressure by means of the pipe I, rises to the same extent, carrying up the filling and overflow vessel F, and maintaining the original level of liquid in the loading-tank, and thereby maintaining the maximum outlet pressure. The float D rises and falls in the tank E, which is provided with an overflow at K; the float having attached to it the bell C. The pipe I is open above the water-level, and communicates to the inlet division of the gas chamber at the bottom, or it may communicate direct with the inlet main, so that the inlet pressure is brought to bear upon the bell C, and, through it and the float D, upon the overflow-vessel F.

Production of Illuminating Gas from Liquid Hydrocarbons.—Lewes, V. B., of Greenwich. No. 16,258; Sept. 10, 1892.

In the inventor's former patent (No. 21,598 of 1891*), he described a combined process of producing carburetted hydrogen by "cracking" liquid hydrocarbons in the presence of water gas and incandescent fuel, and diluting the resulting gas by mixing it with hydrogen simultaneously produced in a separate generator by the action of steam on heated iron. Since the date of the patent, he states that he has discovered that part of the combined process—viz., the method of "cracking" crude oils and hydrocarbon oils of considerable density, such, for example, as crude petroleum—may, in the manner hereafter explained, be used otherwise than as a part of the combined process described in the earlier specification, so as to produce therefrom combustible permanent gases of high illuminating value, and which may be used *per se*, or "for enriching coal gas, or for carburetting water gas, hydrogen, or other non-luminous gases."

In the processes heretofore proposed to be used, says the patentee, for decomposing crude hydrocarbon oils or liquid hydrocarbons, so as to obtain from them gases of high illuminating value, retorts have been employed, in such a manner that the deposition of carbon and pitch has been so great as to rapidly choke the retorts and tubes or superheating chambers used in the manufacture; and when it has been attempted to decompose the oil, by allowing it to flow by gravity into a mass of incandescent fuel, the decomposition has been carried too far, so that the hydrocarbon gases valuable for illuminating purposes have been decomposed into others of low light-giving power. The processes so proposed for use have been unsuccessful, because proper provision has not been made for carrying them into effect at the high temperatures necessary. It has been ascertained that, when oil of the kind mentioned is injected with superheated steam, at considerable pressure, into incandescent fuel within a suitable vessel—such as is hereafter referred to—provided with means for introducing blasts of air, the steam attacks the red-hot carbon of the fuel, forming water gas, which protects and dilutes the vaporizing oil. The decomposition of it is arrested before it has gone too far; and, as a result, a permanent gas of high illuminating value is obtained, while the carbon and pitch deposited from the oil when "cracked" remain with, and increase the quantity of, fuel in the gas producer or generator, instead of choking the apparatus. An additional quantity of steam may with advantage be injected into the incandescent fuel, at a point below that at which the oil is injected; and this additional steam is converted by the incandescent fuel into water gas, and serves to "sweep up" the hydrocarbons and drive the oil gas out of the fuel.

Fig. 1.

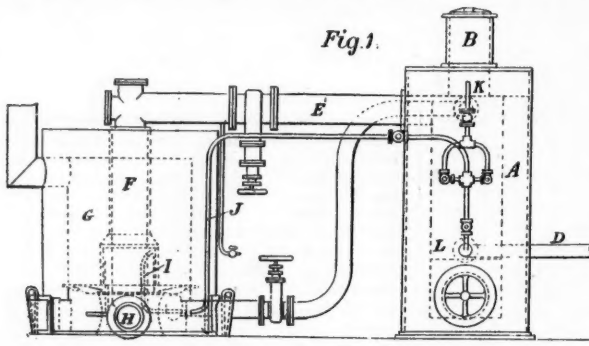


Fig. 2.

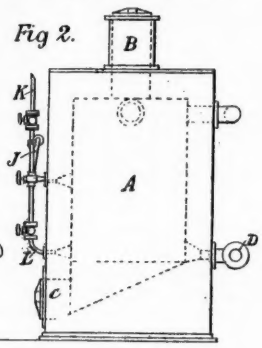


Fig. 3.

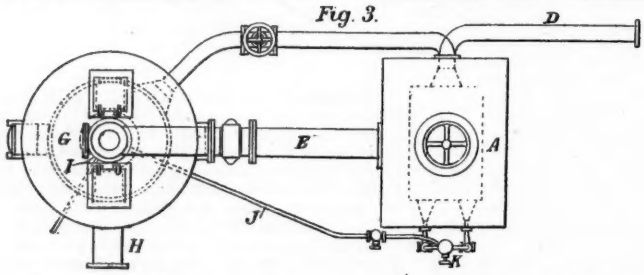


Fig. 1 is a side elevation, fig. 2 an end elevation, and fig. 3 a plan of the apparatus employed.

A is a gas-generator, comprising an outer metal casing lined with refractory material, and provided with an inlet B for fuel and an outlet C for clinker, both normally closed by doors. D is a pipe, through which air can be blown into the lower end of the gas-generator; and E is a pipe with a valve, connecting the top of the gas-generator with the top

* See JOURNAL for April 11, p. 644.

of an iron fixing-retort F. This is used in connection with the gas-generator, and is located within a superheater furnace G. H is the outlet of the retort. The top of the gas-generator is connected with the ash-pit, below the fire-grate bars in the superheater furnace. I is a steam superheating coil-like chamber or coil cast in the wall of the retort, or embedded in a thick mass of iron or other suitable material, to prevent its being burnt. This superheater is connected with a steam-generator (not shown), and with a steam supply-pipe J. K is an oil supply-pipe, provided with branches connected respectively with two injectors, advantageously arranged to discharge liquid hydrocarbons into the incandescent fuel in the gas-generator at points about midway in their height. The steam supply-pipe J is connected with the injectors, and also with a nozzle L, located near the bottom of the generator.

The mode of working, and the action of the apparatus, are as follows: Carbonaceous fuel (such as coke) is introduced into the gas-generator, and raised to incandescence by a blast of air forced through the pipe D, from a suitable blower. The products of combustion—largely consisting of carbon monoxide and nitrogen—are led to the superheater furnace G, the combustion of solid fuel in which is supplemented by the combustion of the carbon monoxide in the products. By this means, the fixing-retort F and superheater I are heated to the required temperature. The air-blast is then cut off; and the steam and liquid hydrocarbon supply are turned on. Steam under pressure is then driven through the superheater and into the pipe J, whence part passes through the injectors into the incandescent fuel in the gas-generator (spraying in at the same time liquid hydrocarbon, which is fed to the injectors through the supply-pipe K), while from time to time, as may be required, steam can be admitted through the nozzle L into the lower part of the generator. Satisfactory results are claimed to have been obtained by injecting oil—such as crude petroleum—by means of steam, at a pressure of about 120 lbs. to the square inch, and heated to a temperature of about 400° C.

By thus injecting the oil into the mass of incandescent fuel, it is "cracked" to gas. Any carbon, pitch, or the like, merely add to the fuel in the gas-generator; while "over-cracking" is prevented by the simultaneous generation of water gas from the steam used in injecting. The oil gas thus formed flows from the top of the generator through the pipe E to the fixing-retort F; and this, being kept at an approximately constant high temperature of (say) about 1000° C., uniformly fixes the gas, so as to produce permanent illuminating gas. Steam may from time to time be also injected through the nozzle L into the incandescent fuel, at a point below that at which the liquid hydrocarbons are being cracked; and in case of overheating, or at the end of each run, the hydrocarbons in the gas-generator may be "swept out" by an upush of water gas, produced by the decomposition of the steam thus injected.

The production of oil gas in the manner described may, says the patentee, be advantageously continued, until the temperature of the fuel in the gas-producer has fallen below the required point; and then the steam and liquid hydrocarbons should be shut off, and the various connections adjusted as before, for the passage of the air-blast, in order to again raise the fuel in the gas-generator to the desired degree of incandescence.

The relative quantities of the steam and hydrocarbon admitted through the injectors into the incandescent fuel, should be so regulated that the gas generated in the fuel chamber A is of a brown colour, as seen by a pet-cock, through which a small quantity of gas can escape from time to time from the pipe E. If the gas thus allowed to escape be white, it indicates that the oil is not sufficiently cracked, and the proportion of steam should be reduced; if the gas be black and "sooty," it indicates that the oil is being over-cracked, and the proportion of steam should be increased.

The patentee concludes his specification by saying: "I am aware that it has been proposed to produce illuminating gas from oils of the kind hereinbefore mentioned, by injecting the oil with steam through red-hot tubes, into closed chambers or retorts; but this method has not been successful, because the steam has injuriously attacked the oil, whereas by injecting the oil and steam into incandescent fuel by my method, the steam attacks the red-hot carbon in the fuel in preference to the oil, with the result that a permanent gas of high illuminating value can be obtained. I am also aware that it has been proposed to inject liquid hydrocarbon with steam into the mass of incandescent fuel remaining in the retorts ordinarily employed in producing illuminating gas from coal, after the volatile gases have been practically driven off from such coal by external heat; but such propositions have not been successfully carried into practice, because, as before stated, proper provision has not been made to obviate the difficulties which are caused by the rapid lowering of the temperature of the fuel, which in practice would fall to a point below that at which the decomposition can be successfully carried out, and by the absence of means such as are employed by me for raising, as required, the fuel to a suitable state of incandescence."

APPLICATIONS FOR LETTERS PATENT.

7991.—SIMPSON, S., "Prepayment mechanism, applicable to gas, electricity, and like meters." April 20.

7996.—WRIGHT, G. E., "Flame deflectors of gas cooking apparatus." April 20.

7997.—WRIGHT, G. E., "Heating water by gas." April 20.

8010.—NEUFF, E., and QUIN, G. W., "Gas-burners and steam-governors." April 20.

8140.—SIMPSON, W. E., "Gas and other hydrocarbon engines." April 22.

8280.—JONES, F. G., "Gas or oil engine." April 25.

8371.—MERRIFIELD, L. L., WESTCOTT, J. T., and PEARSON, W. H., jun., "Manufacture of carburetted water gas." April 25.

8409.—WILKINSON, G., "Gas, oil, and like power motors." April 26.

8484.—KELLY, J. J., "Reversing valve-boxes for regenerative gas-furnaces, and mechanism for operating the valves." April 27.

8492.—HARRIS, F. J., "Collecting and condensing the smoke arising from gas or other burners as applied to lighting apparatus, such as hanging lights, brackets, &c." April 27.

CORRESPONDENCE.

[We are not responsible for opinions expressed by correspondents.]

Impressions of the Meeting of the Incorporated Institution of Gas Engineers.

SIR,—Before the impression fades from my mind, I would like to record what I saw and felt at the meeting of the Incorporated Institution of Gas Engineers in London this week.

I attended the meeting on the invitation of one of the members of the Council, and was by no means unwilling so to do. I knew that I should meet there several men whom I well respect; and, in these sad days of painful divisions, that was no small consideration. Again, Mr. George Livesey was down to read a paper; and there again was attraction enough to overcome any scruples I might have in accepting the invitation.

I heard Mr. Livesey read his paper, and it reminded me of the old days. There was all the old force and vigour both in matter and expression, with a certain mellowness in the reader—the growth of a constantly widening experience, and of difficulties encountered and overcome. After that, however, sitting there, I felt there was little or nothing more to charm me. The desultory, and weak, and inconclusive discussions that followed the reading of the papers could not divert my vagrant thoughts, that travelled back to the more masculine proceedings of the united and enthusiastic gatherings of past years. I saw none, or but few, of the old hard-headed gas engineers and managers who were wont to grace the benches, and narrate their garnered experiences for the benefit of younger men. Instead of these, I found a plethora of beardless chemists painfully in evidence, and prone to carry on a desultory conversation with each other from opposite sides of the hall, which I thought ought not to have been tolerated by the President.

I could not help remarking on another feature of the meeting. I had been labouring under the impression that the meetings of the new Institution were sacred to members of the gas profession, and that traders were rigorously excluded. Much to my surprise, this is not so. I am not finding fault with this. On the contrary, I was glad in one sense that the impression I had entertained was a wrong one. True, I expected and believed that the promoters of the new association would carry out the views which they had vented so strongly at the time of its formation; and therefore it is not to be wondered at that I should have "shrunk as from a blow" on finding how I had been deceived.

I repeat that I am not finding fault with the presence of the traders. As a matter of fact, their absence from such meetings would create a hiatus that could not otherwise be filled. But does it not expose the hollowness of the assertions that it was this which caused the lamentable secession from the parent Institute?

It is not to the respectable and experienced manufacturer of gas plant and apparatus that any of us can object. He fills, with his practical knowledge, the void which without him would remain a void in the discussions on most subjects connected with gas engineering and manufacture. It is the mere *touter* who should be carefully ostracized—the man who skulks behind lamp-posts in the street, waiting for any weak members who come along to the meetings, and tempts them to turn their steps in an opposite direction. I have been a witness to this more than once, and have been grieved, not to say disgusted, to think how remiss was the Executive that admitted such men to the privilege of membership. So far as regards the old Gas Institute, the mistake will gradually and surely right itself; and in the meantime let us each strive hopefully for reunion.

THOMAS NEWBIGGING.

Manchester, May 13, 1893.

Reductions in Price for Increased Consumption.

SIR,—In your issue for the 2nd inst., you refer to the West Kent Gas Company as having initiated a unique arrangement for stimulating the consumption of gas. Permit me to say that we have had in operation, for more than a year, an arrangement similar in every respect, with the exception that we allow a reduction of 1s. per 1000 cubic feet upon the increased consumption. I had the details of the system from Mr. G. Anderson, of London, who introduced it some years ago into several of the towns he supplies with gas, as a means of saving the cost of a separate meter for registering the gas consumed for cooking, heating, &c., in cases where a lower price is charged for gas for these purposes. The arrangement is giving every satisfaction here; and we expect a largely increased consumption this year, as we are hiring out gas-stoves.

J. DONALDSON.

Cambuslang, May 10, 1893.

Improvements at the Matlock Bath Gas-Works.—The Matlock Bath Gas Company are carrying out considerable extensions at their works. They comprise the enlargement of one of the gasholders, the provision of a steam-pump, overhead tanks, steam-engine and boiler, new waggon weighbridge, and the renewal of the mains in the township of Cromford. The total outlay will be about £750.

A Gas Company Fined.—The Bolton County Magistrates (Messrs. Lee and Armitage) heard a case on Monday last week in which the Blackrod Gas Company were defendants, and Mr. Halstead, Inspector of Weights and Measures for the County Division of Bolton, was the prosecutor. The charge was one of having an unjust scale in use; and the evidence showed that the officer visited the premises and examined an old cart weighing-machine which had been employed for weighing coke sold by the Company, and also for weighing coal bought by them. The scale was 1¼ cwt. wrong; and when the Company sold coke, the public benefited. But, on the other hand, the Company profited when they themselves were purchasers. Defendants said the machine had got out of order by reason of the traction-engine having just previously been up the road. A fine of 10s. and costs was imposed.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following progress was made with Bills last week :—

Bills read the first time and referred to the Examiners: Electric Lighting Provisional Orders Bills (Nos. 5 and 6), relating to Reading and Islington; South Staffordshire Water Bill.

Bill read a second time and committed: Electric Lighting Provisional Orders Bill (No. 2).

Bills reported, with amendments: Bilston Commissioners Water Bill; East Stonehouse Water Bill; Electric Lighting Provisional Orders Bill (No. 2); Plymouth Corporation Water Bill.

Bills read the third time and passed: Crystal Palace District Gas Bill; Runcorn Commissioners (Water) Bill; Weaver Navigation Bill.

Bills Royal Assented: New Swindon Gas Bill; Rathmines and Rathgar Water and Improvement Bill; Salford Improvement Bill; Staines and Egham District Gas Bill.

Bill withdrawn: West Hampshire Water Bill.

HOUSE OF COMMONS.

The following progress was made with Bills last week :—

Bills read the first time and referred to the Examiners: Crystal Palace District Gas Bill; Runcorn Commissioners (Water) Bill; Weaver Navigation Bill.

Bills read a second time and committed: Electric Lighting Provisional Orders Bills (Nos. 3 and 4).

Bills referred to a Select Committee, consisting of Mr. A. de Tatton Egerton (Chairman), Mr. Provand, Mr. Darwin, and Mr. Angus Holden, to meet on Monday, May 15: Accrington Gas and Water Bill; Electric Lighting Provisional Order Bill (No. 1).

Bills reported: Aberdeen Corporation Bill; Bodmin Water Bill.

Bills read the third time and passed: London County Council (General Powers) Bill; Sheffield Corporation Water Bill; South Staffordshire Water Bill.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

Tuesday, May 9.

(*Before Justices* CHARLES *and* VAUGHAN WILLIAMS.)

Loveland v. The Gaslight and Coke Company.—Electric Light Boxes and Gas Explosions.

The plaintiff in this case brought an action against the defendants to recover damages for injuries sustained through an explosion of gas caused, as was alleged, by their negligence. The case was tried in the Lord Mayor's Court on the 22nd of February last, by the Recorder (Sir C. Hall, Q.C., M.P.), and a special jury, and the plaintiff obtained a verdict, with £40 damages (see *ante*., p. 364). It was now sought to set aside the verdict, on the ground that there was no evidence of negligence to go to the jury.

Mr. M'INTYRE appeared for the plaintiff; Mr. BIGHAM, Q.C., and Mr. MORTEN represented the Company.

Mr. BIGHAM, in opening the case for the appellants, said the action was brought by Mr. Loveland against The Gaslight and Coke Company for damages on account of personal injuries he had sustained in connection with an explosion of gas; and the question for their Lordships to decide was whether there was any evidence to go to the jury on the issues raised on the pleadings. Most of the facts were admitted so far as the accident was concerned; but there was a dispute as to what was the real cause of the explosion. It took place in Great Tower Street; and it was important to bear in mind the relative position of the different points. Harp Lane ran north and south; and Great Tower Street, east and west. On the right and left of Harp Lane, where it entered Great Tower Street, were two electric light boxes, with lids of stone. These boxes were not air-tight, but were more or less water-tight; and they contained the coils of wire supplying the electric current to the lamps. On the 14th of October last, the defendant Company's men were working to the east of the box where the accident happened, using picks for the purpose of taking up the concrete, in order to get at some leaky gas-pipes; and at nine o'clock at night, the electric lamp over one of the two boxes in question being lit, there was an explosion of gas, which had in some way gathered in it. The explosion was of such force that the lid of the box was smashed to pieces; and the pressure of air forced up the lid of the other box, on which the plaintiff was standing. It was suggested by Counsel for the plaintiff that the mere fact that there was a leakage in the main of the Gas Company was in itself evidence that the main had originally been improperly laid; but he thought it only required to be stated, to show that there could be nothing in that point. Then, it had been contended that, as the evidence showed the leakage had existed for some time, this proved negligence on the part of the Company in not having discovered it sooner. The first point was that there was a negligence of commission in improperly laying the pipes; and the second, that there was negligence of omission in not finding out the leakage sooner. The third head suggested seemed to him an extraordinary one—that the men in using their picks had caused sparks, which had ignited the mixture of gas and air, and thus brought about the explosion. The negligence alleged under that head was in not putting down matting, or something of that kind, to extinguish the sparks made by the picks. He contended there was absolutely no evidence to support any of those suggestions.

Justice WILLIAMS: Your Company have statutory authority for laying and maintaining their pipes in the streets?

Mr. BIGHAM: Yes.

Justice WILLIAMS: I supposed we may take it that the gas ought never to have been in the box?

Mr. BIGHAM: Clearly.

Justice WILLIAMS: Then is your proposition similar to that put forward in the railway case, "Do what you like, engines will jump." Do you say: "Do what you like, gas will escape?"

Mr. BIGHAM said all that the Gas Company were required to do was to act as reasonable men, and to take all reasonable precautions; and notwithstanding that this was done, experience showed that gas would escape. It did not follow because gas escaped, that there was any negligence or breach of duty.

Justice WILLIAMS referred to the case of *Hammond v. The Vestry of St. Pancras*, in which the action was brought against the Vestry for the escape of water through a sewer. The suggestion of the Vestry was that the escape of water was not owing to any works of theirs, but to some ancient drain which still existed. They contended that there was no evidence of any negligence on their part; and there was considerable discussion as to whether the mere escape of the water was not evidence of negligence. The conclusion arrived at in that case was that it was not the escape of the water, but the not finding it out sooner, and allowing it to continue, which constituted negligence.

Mr. BIGHAM said there might be evidence of negligence in the present case, if the Gas Company had had opportunities of finding out the escape, and had not used reasonable means to do so. The plaintiff's story was that at nine o'clock in the evening on the 14th of October, he was standing on the east box of the Electric Light Company reading some paper, when he was thrown up into the air, and was hurt. He did not appear to have been able to tell the jury anything at all about the other circumstances of the case, further than that he saw the Company's men working in the road about ten yards away from him. The evidence of Joseph Ansell, the housekeeper at 21, Great Tower Street (the City Meters' Office), was that for about a week before Oct. 14, they had noticed a very strong smell of gas in the house. It was important to remember that there was no evidence of anybody having noticed a smell of gas elsewhere than in the house. The pavement outside was of concrete; and if there was an escape of gas from the mains, it would find its way laterally through the earth, under the foundations of the building, and then into the house where the smell was discovered. The witness Ansell said he had made a complaint to his superiors; but that had not reached the Gas Company, who had never heard of it until the afternoon of the day when the explosion happened. Another witness named Rayden, a clerk in the same office, said he had noticed the smell of gas for twelve months, and that it was sometimes so bad that he could hardly bear to be in the place. That evidence was certainly very strong; and it looked as if the witness had an exceedingly sensitive sense for smell. The question was whether there were any means by which the Gas Company could have discovered the leak. They could not go inside houses, smelling about for a possible escape of gas.

Justice WILLIAMS: Do you say that the Gas Company have no means at all by which they can discover whether or not their mains are in a leaky condition?

Mr. BIGHAM said he did not go so far as that. The Company did send round men called leak detectors, to examine the syphons and water-boxes; but they could not be periodically digging up the streets, in order to look for leaks, of which there might be no evidence whatever. The syphon-boxes were placed there, not for the purpose of detecting leaks, but for pumping away any water that might collect. Mr. Foulger, in his evidence, said that, in his opinion, the explosion was caused by the gas going up the electric column, and being ignited at the light itself. He knew by experience that gas explosions had been caused by electric lights. The pipes were sound in condition; but the joints had given way, owing to a subsidence which left the pipes without support.

Justice WILLIAMS said it seemed that the Company's case was that the pavement was of such a character that no escape of gas from the mains would be noticeable in the streets; but, owing to the hard impervious crust, it must find its way into the house.

Mr. BIGHAM said it was probable that, if the leak had been going on for another month or two, it would not have been discovered by the ordinary leak detectors.

Justice WILLIAMS said in that case he could not understand why they were sent to these streets. According to the defendants' evidence, the leak detectors were sent there every week; and yet the argument was that, if there were a leak, they would not be able to find it out.

Mr. BIGHAM said, for aught he knew, the gas might find its way out to these electric light boxes. He could not say with absolute certainty that it would not; but he would ask their Lordships what was the evidence of the Company's negligence.

Justice CHARLES said he did not mind answering that question. According to the evidence, the pipes were in a bad condition; they had been laid nearly nine years ago. The leak detectors went there every week; but, according to one of the witnesses, the smell of gas had been noticed for nearly twelve months.

Justice WILLIAMS said the onus was on the Company to show that, by the exercise of a reasonable amount of care, they could not have discovered the leak.

Mr. BIGHAM said he proposed to show that that onus had been discharged in such a way that there was nothing to go to the jury. What was the reasonable care which it was suggested they ought to have exercised, that would have enabled them to find out the leak, which was never noticed anywhere, and could not have been detected anywhere, but in the house?

Justice WILLIAMS said the Gas Company, in the exercise of their ordinary practice, had sent a man to the street once a week, to ascertain whether or not the gas was escaping. The inference to be drawn from that was that it was possible, by that sort of examination, to ascertain whether or not there was a leak. They had not called the leak dedector, to show that there was anything special in this case.

Mr. BIGHAM said the Company had called Mr. Pilbrow, to whom the leak detector would report; and he stated that, until Oct. 14, he had received no intimation whatever of any escape of gas at that spot. Then Mr. Marsh, a foreman fitter, in his evidence stated that he went

to Great Tower Street on Oct. 14, at about 5.30 p.m. He found there was no leakage at the City Meters' Office. Before making an opening outside, he did not notice a smell. He was there when the explosion occurred; but he did not see the man blown up, as his back was turned that way. He had made an entry, "Explosion in electric-light box, caused by light by picking the concrete." That was because the men who were at work there told him that was how it happened. The learned Counsel then proceeded to read the summing-up of the Recorder; and he concluded by submitting that the verdict of the jury ought to be set aside.

Their Lordships then delivered judgment, without calling upon Counsel for the plaintiff.

Justice CHARLES said in this case they were invited to say that there was no evidence of negligence on the part of the defendants to go to the jury; and they were asked to enter judgment for the defendants, in place of the judgment for the plaintiff which followed upon the verdict of the jury in the Lord Mayor's Court. Now, the action was one for personal injuries sustained by the negligence of the defendants. In Great Tower Street, the defendants' mains run along in front of the houses Nos. 20 and 21; and, on the evening of the 14th of October, the plaintiff was on the footway near to the corner of Harp Lane. While he was standing on an electric-light box, an explosion took place at another electric-light box upon the other side of the street. The explosion, which shattered the lid of the other box, lifted the lid of the box upon which the plaintiff was standing; and he was thrown to the ground, and sustained injuries. The plaintiff brought an action for damages in the Lord Mayor's Court, alleging that the explosion occurred owing to the defendants' negligence. It was proved by the evidence of persons resident in, or employed at No. 21, Great Tower Street, that for a long period prior to Oct. 14, there had been a smell of gas in that house. This smell was sometimes extremely bad, and sometimes not so bad; but it was always there, and had been for months. Two entries made by the defendants themselves, as to the state of the main opposite No. 21, had been put in, which disclosed that there were two leaky joints in the main. There could be no doubt, having regard to the evidence, that those were leaky joints of long standing. In that state of things, the defendant Company asked the Recorder to stop the case, on the ground that the plaintiff had not proved negligence on their part. The Recorder very properly declined to stop the case; and thereupon the defendants took upon themselves the onus of showing that the state of things in the main, and the existence of those leaky joints, could not by reasonable care have been known to them. He was of opinion that they had signally failed to prove it. On the contrary, their evidence supplemented to a considerable extent the evidence offered on the part of the plaintiff, for it turned out from the statements of the defendants' witnesses, that the Company were in the habit of taking steps to see if their mains were in order. They employed men called leak detectors and also persons called pumpers, who used instruments called leak detectors for the same purpose, to go round once a week to the mains of the Company. If these persons did their duty, they would go to that place weekly; and they would therefore have been there within a few days of the time that the accident happened. They were not called as witnesses for the defence; and all the defendants had proved was that no report had been received from any of their leak detectors with regard to the state of those joints. The evidence called on the part of the defendants, proved that the leaks were old ones. The ground had fallen away; and one leak was a very bad one. Looking at that evidence, he was of opinion that the defendants had failed to discharge the onus thrown upon them to show that they had exercised reasonable care. They had not thought fit to produce any evidence from the persons whose duty it was to make periodical inspections. The jury were amply justified in finding that this leak was one which might have been discovered by the Company, by the exercise of reasonable care; and the verdict would therefore stand.

Justice WILLIAMS said he was of the same opinion; and he should add nothing to what his learned brother had said, if it had not appeared to him, in the course of the argument, that there had been some misapprehension in the case as to the onus of proof. The evidence given on behalf of the plaintiff clearly showed injury to him, caused by an explosion, resulting from an escape of gas through leaks in broken joints of the defendants' mains. That alone, in his judgment, was evidence of a nuisance caused by the defendants, which nuisance had injured the plaintiff. It would be a good defence for the Company to show that they could not have discovered the leak in question by taking reasonable steps, and by the exercise of reasonable skill and care; but the onus of establishing this was on the defendants. The condition of the Gas Company's pipes was shown to have been defective for some considerable time; and that defective condition led to the injury sustained by the plaintiff. That, as he suggested, was a *primâ facie* case; and the defendants thereupon had cast upon them the onus of showing that they did everything which they reasonably could do to detect the leakage. In his opinion, they had not discharged that onus. Their practice was shown to have been to send inspectors every week to detect leaks; and they had done that even in streets paved as was the street in question. That showed that the defendants expected to find leaks, if they existed, even in streets so paved. Now, the defendants had not attempted to explain how they came not to discover the leaks in question. They might have called the inspectors, and also scientific evidence, to explain the process of inspection, and how it was the man had not found the leaks; but they did not choose to do anything of the sort. He thought they had failed to discharge the onus which was cast upon them by the plaintiff's evidence; and the appeal would be dismissed with costs.

Mr. MORTEN said the judgment was one of great importance to the Gas Company; and he therefore asked for leave to appeal.

Justice CHARLES said the Court could not accede to the application

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(*Before Justices* GRANTHAM *and* VAUGHAN WILLIAMS.)

The Queen v. Justices of Frodsham, Cheshire—A Question as to Levying a Lighting Rate.

This case raised a somewhat important practical point as to levying local rates—whether, when the rate has been made by local authorities under an optional Act which has been adopted by the inhabitants, the Magistrates, when called upon to issue a warrant to levy the rate on an individual, may require it to be proved that the Act has been regularly and legally adopted. The case had arisen as to a rate made under the Lighting Act of 1833 (3 & 4 Will. IV.), which was adopted in 1871 in the township of Frodsham, in Cheshire; and in July last there was a precept to the Overseers to levy £85 as the amount required for the expenses of the inspectors of the district for lighting under the Act. The Overseers accordingly made a rate in which one Edwards was included; and as he did not pay the rate, which had been duly allowed by the Justices, the Overseers applied to the Magistrates to issue their warrant of distress to levy the rate upon him. The rate was good on the face of it, and had been allowed. The Justices, however, required proof of all the formalities necessary for making a legal rate; and accordingly this was offered—that is, proof of notice of meeting, and of a meeting accordingly held in 1871, when the Act was adopted, and proof that ever since then the district had been lighted and rates made under the Act, and that on Jan. 28, 1892, the annual meeting of the ratepayers was held, after notice on the church doors for a Sunday previous, at which meeting a rate for £85 was resolved upon, &c. It was, however, objected that the notice ought to have been on the church doors for the two previous Sundays, and that therefore the rate was bad. The Magistrates came to the conclusion, without giving any reasons, not to issue their warrant of distress; and thereupon this rule for a *mandamus* was obtained. The Justices, in an affidavit, stated that no evidence was given that an application had been made by three ratepayers to the Overseers to convene the meeting to determine whether or not the Act should be adopted.

Mr. SHEPHERD LITTLE appeared for the ratepayer to show cause against the *mandamus;* Mr. E. H. LLOYD appeared in support of it.

The Court to-day came to the conclusion that the Magistrates were wrong in asking for such proof as they had required, and that therefore the *mandamus* must issue.

Justice GRANTHAM, in giving judgment, said the Justices ought to have issued their warrant of distress. It was not necessary for them to require evidence to be given that the Act had been regularly put in force; and, indeed, the present Overseers might not be in a position to give such evidence. The rate had been duly allowed by the Justices; and the presumption was that the Act had been legally put in force.

Justice VAUGHAN WILLIAMS concurred; observing that the action of the Justices in issuing the warrant would be ministerial, though, if there was evidence given that the Act had not been legally adopted, their function might be deemed judicial. But, in the absence of such evidence, and after the rate had been duly allowed by the Justices, the Magistrates ought to presume that the Act had been legally adopted.

A Labour Club and their Gas Account.—At the Accrington Police Court last Wednesday, the five Trustees of the Independent Labour Club were summoned by the Accrington Gas and Water Company for non-payment of their gas and water account. The Company had cut off the gas supply just before a dance took place; and this function had to be carried out with the aid of borrowed oil-lamps. The amount owing was £16 6s. 3d. The Magistrates adjourned the case for a week; it being understood that, meanwhile, the account would be paid. The question raised by the defence was one of liability for the amount.

Exhibitions of Gas Appliances.—The following firms have recently held successful exhibitions of gas appliances: The Davis Gas-Stove Company, Limited, at Cheshunt, Hinckley, and Portsmouth, with cookery lectures by Mrs. Springthorpe, Miss Rotherham, and Miss Ellen Johnston; Messrs. Fletcher, Russell, and Co., Limited, at Birkenhead, Bristol, and Wigan; Messrs. Richmond and Co., Limited, at Malvern and Stonehaven, with lectures by Miss Owen and Miss Leng; the Scottish Gas-Stove Company, in Newcastle-on-Tyne and Worcester, with lectures by Miss Burdon and Miss Phillips. The Lea Bridge District Gas Company held a very successful exhibition from the 3rd to the 6th inst., at the Victoria Hall, Walthamstow. Mrs. Wilkinson gave most instructive and useful lectures twice each day to large audiences, on the excellent results to be obtained by the use of gas-stoves. Messrs. Fletcher, Russell, and Co. exhibited a large number of their cooking-ranges and other gas appliances. The lighting section of the exhibition was taken up by Messrs. Lilley and Co., of Stoke Newington, Messrs. W. Sugg and Co., Limited, and Messrs. Bromhead and Co. Numerous interesting gas appliances were on view—viz., the "penny-in-the-slot" meter, and other plant, by Messrs. W. and B. Cowan; model gas-works, &c., by Messrs. T. Glover and Co.; large test meter, by Messrs. A. Wright and Co. The arrangements were carried out by Mr. W. Thorman, the Company's Manager.

The East London Water Company and their Consumers.—At the Thames Police Court, last Friday, Mr. G. Kebbell, Solicitor to the East London Water Company, applied to Mr. Dickinson, the sitting Magistrate, for a number of summonses against consumers for non-payment of their water-rates. Mr. Kebbell informed his Worship that it had hitherto been the practice, in cases of default, to disconnect the water supply; but the East London Company, in view of the danger to health arising from such a practice, had now determined to abolish it. For the future they would endeavour to recover rates due to them through the medium of the Police Court. He was sure this decision would commend itself to the approval of his Worship and the public generally; and he took the opportunity of expressing a hope, in view of a not exceedingly remote prospect of a water famine, that consumers would do all in their power to assist the Company in their endeavours to continue a good supply of water. At the same time it was necessary to say that if, after the hearing of the summonses, the order to pay the rates was not complied with, the Company would have no option but to cease supplying the defaulting consumers. Mr. Dickinson said he felt sure that, in view of the prevailing dry and warm weather, everyone would agree with the commendable action of the Company. If Mr. Kebbell would write out a statement of the various enactments bearing on the application, he would consider it, and afterwards fix a day for the hearing of the various summonses asked for.

MISCELLANEOUS NEWS.

BIRMINGHAM CORPORATION GAS AND WATER SUPPLY.

Annual Report of the Gas Committee.

The annual report of the Gas Committee of the Birmingham City Council for the year ended March 31 last has been issued. It states that the inclined retort-settings at Windsor Street having been completed, it has become desirable, before determining on any further extension of them, to compare their working with the present retorts when charged by machinery. They have for this purpose authorized an expenditure of £3357 on the provision of Messrs. Arrol's hydraulic charging-machines, with the necessary hoppers, coal breaker, elevator, and conveyors, to be applied to the section of the new retort-house in which hydraulic drawing-machines are now employed. These charging-machines have been in operation with very favourable results, at the Glasgow Corporation Gas-Works. The attention of the Committee has been directed to the growing employment of machinery in large gas-works for the removal of coke from the retort-houses to the loading or stacking ground. The provision of the crane for stacking or loading coke at Saltley has facilitated the application of such machinery to the work there; while at Windsor Street it can be readily applied, as it now is in some of the London gas-works, to the large quantity of coke which is loaded into carts and vans for the town trade. They have authorized an expenditure of £3644 on the provision of such machinery for dealing with the coke in one section of No. 3 retort-house at Saltley, and of £2884 on machinery for dealing with about one-fourth of the output at the Windsor Street works. In connection with the use of this machinery, it is proposed to employ revolving screens, as at the Sheffield Gas-Works, for separating the breeze and large and small coke. The Committee have accepted the following tenders in connection with these extensions: Sir William Arrol and Co., Limited, charging-machines and coal-hoppers, £1510; Chain-Belt Engineering Company, coal breakers, elevators, and conveyors, £1497; West's Gas Improvement Company, Limited, coke-conveying machinery, £2384; Chain-Belt Engineering Company, coke-conveying machinery, £2919. An expenditure of £1408 in extending the subways under No. 3 retort-house at Saltley has been authorized; and £421 in repairing a portion of the floor girders and the floor of the same retort-house. The Committee report that they have received a memorial from the short-term carbonizers asking that, instead of the Bank Holidays now granted to them at Christmas, Whitsuntide, and in August, they should receive one day for three months, three days for six months, and four days for eight months' work per annum. The Committee, after careful consideration of the question, have informed the memorialists that they are not able to comply with the request; but they have authorized the Engineers to give in future to short-term carbonizers, in substitution for the Bank Holidays, one day's holiday for each four months' consecutive work, subject to the present conditions as to forfeiture for neglect of work or irregular attendance. The cost of these additional holidays is estimated at about £114 per annum; bringing up the total present annual cost of the workmen's holidays to £1500. The Committee have made (a little earlier than usual in the year) the contracts for the coal that will be required at the different works in the year beginning on July 1 next. It will be remembered that, in making their contracts last year, they had to introduce coal from fresh districts to two of their works—the prices having been exceptionally maintained in one of the districts from which they had been accustomed to draw a considerable portion of their supplies. Finding that this condition of things no longer exists, the Committee have reverted to the former sources of supply, and have obtained a satisfactory reduction on the contracts which have now been made. In connection with these contracts, they understand that three of the four railway companies who carry the coal have withdrawn the recent advance on coal rates. With regard to the railway rates for coke and other materials sent in to or delivered from the gas-works by rail, the Committee have not yet been advised by the railway companies of the final result of the revision which is now in progress.

The Committee submit their balance-sheet and statement of accounts for the year ended March 31, showing a net profit amounting to £27,966. No appropriation has been made from the profits of the year to the sinking fund for the redemption of loans and annuities, having regard to the large sum which has been placed to this fund from the profits of previous years. The Committee recommend that the balance of net profit shall be appropriated to the improvement rate of 1892. They have informed the Finance Committee that they hope to be able to pay to the improvement rate the sum of £25,000 out of the profits for the year ended March 31, 1894. The cost of repair of meters for the past year has been £5409; and the number repaired, 7967.

The following are the principal items (shillings and pence omitted) of the revenue account, preceded by those of the previous year:—

Expenditure.

1891-92.	Manufacture of gas—		1892-93.
£271,044	Coals	£262,059	
6,442	Purifying materials and wages	12,061	
4,726	Salaries at works	5,102	
56,916	Wages at works	59,303	
76,471	Repairs and maintenance	44,514	
			£383,041
	Distribution of gas—		
12,137	Salaries in light office	£12,154	
16,693	Repairs, maintenance, and renewal of mains and service-pipes	15,380	
6,366	Repairing, renewing, and refixing meters	6,176	
			33,711
2,757	Lighting and repairing public lamps		2,846
15,129	Rent, rates, and taxes		18,581
8,675	Management		9,376
2,507	Law and parliamentary charges, bad debts, bank charges, &c.		3,317
£479,870	Total expenditure		£450,874
114,170	Balance carried to profit and loss account		122,007
£594,041			£572,881

Receipts.

£453,086	Sale of gas	£450,067
135,496	Residual products	117,836
1,928	Rents	1,988
2,370	Fittings	1,744
1,159	Discounts and transfer fees	1,244
£594,041		£572,881

Included in the total receipts from the sale of gas are the following items: Common gas, 1,301,727,000 cubic feet, at 2s. 7d. per 1000 cubic feet, £168,139; ditto, 547,420,200 cubic feet, at 2s. 5d., £66,146; ditto, 1,994,809,300 feet, at 2s. 3d., £224,416; and public lighting and under contracts, £12,036.

Annual Report of the Water Committee.

The Water Committee in their report state that, since the Council instructed them to carry into effect the provisions of their Water Act of 1892, they have been engaged in carrying out the agreements for the purchase of lands and rights belonging to various owners on the watershed area which were entered into with them before the passing of the Act. The following arrangement has been made as to the division of the works to be constructed under the provisions of the Act of 1892, between Mr. Mansergh and Mr. Gray: All the works on the watersheds, the railways, and the aqueduct from the Elan at Careg-ddu to the east end of the Stour Syphon at Hagley, are to be carried out by Mr. Mansergh. The rest of the works, including the Frankley reservoir, the Northfield and Warley reservoirs and tanks, the Birmingham tank, the filter-beds at Frankley, and the mains to and from such reservoirs, are to be carried out by Mr. Gray. One of the most important questions which have engaged the attention of the Committee relates to the construction of the dams of the Caban Coch, Pen-y-gareg, and Craig-yr-allt-goch reservoirs; the question being whether they should be constructed by the Corporation themselves or by a contractor. On Nov. 9 last, Mr. Mansergh, in a general report to the Committee, very strongly recommended that the work should be undertaken by the Corporation, and not through a contractor, and gave his reasons for such recommendation. The Committee felt that it was essential that these dams should be constructed in the way that would best secure their being absolutely safe and watertight; and, in view of the immense responsibility, both legal and moral, resting on the Corporation with respect to these works, they considered that the question of safety was of primary importance. Mr. Mansergh was asked to make a further report to the Committee, dealing specifically with this question; and he accordingly presented a report, in which he went into the matter very fully, and again strongly urged the advisability of the work being done by the Corporation. The Chairman of the Committee in the meantime took steps to ascertain what the experience of the Liverpool Corporation had been on this point. The Vyrnwy dam, which was constructed by that Corporation, appeared to the Committee to be the only work in Great Britain similar in magnitude and importance to that proposed to be erected at Caban Coch. After very full consideration of the whole subject, the Committee have decided that the dams should be constructed by the Corporation. The works in connection with the railway and aqueduct will be tendered for, and let to contractors in the usual way. The works which Mr. Mansergh proposes to begin first are the three dams before mentioned on the River Elan, the railways, and the first section of the aqueduct from the Caban Coch reservoir to Knighton. The referencing of the railways and the first section of the aqueduct has been carefully checked by Captain Price; and notices to treat have been served in respect of the land required for the railways, and also for a part of the first section of the aqueduct. This section is about 21 miles long, rather more than one-third being in tunnel; and the work, therefore, of this portion of the aqueduct will be very heavy.

In their general report, the Committee state that, in order to provide for a better supply to the important districts of Acock's Green and Solihull, they have authorized the laying down of a 12-inch main, at an estimated cost of £4800. This work has now been carried out; the actual cost being only £3702—thus showing a considerable reduction on the estimate. In their report presented to the Council on Feb. 7, 1888, the Committee set forth the extensions of mains and other local works which would be necessary to meet the probable requirements of the district for the next five years. With some exceptions, the whole of these works have now been completed. The exceptions include the 6-inch main for Shirley, of which only 774 out of a total of 3520 yards have yet been laid. The most important exception, however, is that of the duplication of the main from Whitacre to Plant's Brook; and this subject has engaged the serious attention of the Committee. The question is one of grave importance, as while, on the one hand, it has never been satisfactory that the supply of water from the Shustoke reservoir to Birmingham should depend on a single main, on the other, the cost of a second main (estimated by Mr. Gray at £25,000) is very heavy, especially when it is considered that in a few years a supply from this source will be unnecessary, or only occasionally used. After careful consideration, Mr. Gray made a suggestion to the Committee which he believes will meet the case. It is that, in lieu of constructing a duplicate main from Whitacre to Plant's Brook, a branch main shall be laid down in the Tamworth Road to the reservoir at Erdington, at an estimated cost of £4300. By having this duplicate branch main, the Erdington reservoir will be brought into greater use, and the pressure relieved from the Whitacre main at night; and, what is of very great importance, the Engineer will be enabled to deliver so much more water to this reservoir that he can at any time let water from Erdington to Witton, and so be enabled to bring the Upper, Middle, and Lower Witton reservoirs into greater use by filling them up when there is water to spare either at Whitacre or Plant's Brook. The Committee have authorized the work to be carried out; and the necessary grants of easement have been executed. They have succeeded in making arrangements with owners of land adjoining the Longbridge pumping-station for giving the Corporation the right to drive headings under those lands in connection with the well. The extension of the headings is in progress; and it is hoped that, when completed, they will yield some increase in the quantity of water obtainable from the sinking. The work at the hydraulic pumping-station has proceeded satisfactorily during the year; the number of lifts supplied with

power continuing to gradually increase. On the subject of the insurance of water-fittings, the Committee state that the changes that have taken place in the circumstances affecting the system of insurance of fittings have led the Committee to reconsider the whole question. The scheme, which was adopted in 1882, was not so widely adopted by the water consumers as had been anticipated; but, as for some years it paid its way, and was found, so far as it went, to have a good effect on the condition of fittings, there was no reason for interfering with its continuance or operations. The system of stamping fittings has now secured the principal object the Committee had in view; and as, owing to the decrease in the number of insurers, the insurance is now carried on at a loss, which in the last financial year amounted to £454, the Committee have decided to recommend its abandonment. They therefore ask the Council for authority to take all necessary steps for terminating the existing contracts of insurance, and for bringing the operations of the system to a close. The Committee also submit the profit and loss account and balance-sheet of the department for the year ended March 31, 1893. The profit amounts to £4091. This sum being deducted from £10,687, the amount of deficiency on March 31, 1892, leaves £6595 as the deficiency on March 31 last. The sum of £2000, the amount of interest on the reserve fund of £50,000, has been paid to the City Treasurer, as appears in the profit and loss account. The statistics accompanying the report show that the total capital expenditure from Jan. 1, 1876, to March 31, 1893, has been £572,206. The total quantity of water pumped last year was 6111 million gallons. The storeage capacity is now about 645 million gallons, having been increased to that quantity from 200 millions at the time of the transfer to the Corporation.

SOUTH AFRICAN LIGHTING ASSOCIATION, LIMITED.

The Fourth Annual General Meeting of this Association was held at the Offices, 90, Cannon Street, E.C., on Monday, the 8th inst.—Mr. D. FORD GODDARD in the chair.

The CHAIRMAN proposed the adoption of the report and accounts, and alluded to the steady progress of business; the gas sold showing an increase of 16½ per cent. over 1891. This, he said, had been maintained in the current year; the months of January and February showing still further advances. He was gratified to be able to state, moreover, that the leakage had been materially reduced—showing a decline of 3 per cent. on the year; and, although not yet so low as the Directors hoped to bring it, it was now within reasonable limits. The new capital required for the Grahamstown works would be offered to the proprietors in the first instance. The transfer of the land for the works at that town had not yet been effected; but beyond this delay, caused by some purely formal business at Cape Town, no hitch had arisen in the matter. It had been thought advisable, in view of the creation of this new capital, which would not be dividend earning for some little time after its issue, to carry forward the comparatively large balance of £1480; while the Board had deemed it wise to place £500 to a plant depreciation account, to meet any renewals that might be wanted in the future, although they had every assurance from the local officials of the Association that the works were in a high state of efficiency. The sum of £1250 would also be added to the reserve account; bringing this up to £3000—an amount which he thought the proprietors would consider very satisfactory at the end of only four years' working.

Mr. W. WOODALL, M.P., seconded the motion, and it was carried unanimously.

A dividend of 8 per cent. for the year, less the interim dividend of 2½ per cent., was then declared.

Mr. W. Woodall, M.P., a Director, and Mr. J. G. Griffiths, F.C.A., the Auditor, having been re-elected, votes of thanks were passed to the Engineer (Mr. Corbet Woodall), the Secretary (Mr. W. Cash), the Port Elizabeth officials, and the Directors, and the proceedings terminated.

The Lighting of the Opera House, Covent Garden.—The Wenham Company, Limited, are again supplying lamps for use at the Royal Opera House, Covent Garden, during the current spring season.

Increase in the Price of Gas at Darwen.—At a recent meeting of the Gas Committee of the Darwen Corporation, it was decided to increase the price of gas 3d. per 1000 cubic feet as from the 1st of July. The present price is 3s. 3d. The accounts for the past year show a loss of £2300.

The Bolton Corporation and the Use of Street-Lamps for Advertising.—At the last monthly meeting of the Bolton Town Council, a discussion took place with reference to the street pillar lamps being used for advertising purposes. The Gas Committee had given permission to a firm to fix two sample lamps, and had received an offer of £1 per lamp per annum—500 lamps at least to be taken. A member of the Council described the lamps as eye-sores.

New Electric Lighting Works at Leeds.—The temporary plant of the Yorkshire House-to-House Electricity Company, which has been in operation in Leeds since December last has, now been superseded by permanent works, which were formally opened by the Mayor (Mr. Alderman Ward) last Wednesday. The Company was formed in April, 1892; and the erection of the buildings was commenced in August. The plans and specifications were prepared by the Consulting Engineers (Messrs. Hammond and Co.). The engine-room is 68 ft. long by 63 ft. wide; and the plant installed consists of two 200 indicated horse-power engines, one 100 do., two 100 kilo-watt alternators, and one 50 do. The plant is capable of supplying electricity for 7134 35-watt lamps actually burning, or about 15,000 similar lamps installed in houses. The Lowrie-Hall high-pressure system has been adopted. The dimensions of the boiler-house are 52 ft. by 45 ft.; and the boilers—three in number, 30 ft. long by 8 ft. in diameter—are capable of operating at a daily working pressure of 140 lbs. per square inch. The cost of the works up to the present has been about £27,000, exclusive of land; and the Company begin business with 7000 lights on the circuit.

SINGAPORE GAS COMPANY, LIMITED.

The Annual General Meeting of this Company was held last Wednesday, at the Cannon Street Hotel, E.C.—Mr. R. S. FOREMAN in the chair.

The SECRETARY (Mr. R. M. Christie) having read the notice convening the meeting, the report and accounts were, as usual, taken as read. Out of an available balance of £730, the Directors recommended a dividend at the rate of 2 per cent. per annum, less income-tax (making, with the interim dividend, 3 per cent. for the past year); carrying forward a balance of £105.

The CHAIRMAN remarked that the accounts which had been submitted to the shareholders showed that the results obtained by the last half-year's working were not so satisfactory as the Directors had anticipated they would be. At their previous meeting, he mentioned, as the shareholders would perhaps remember, that the Directors hoped to be in a position to maintain the dividend then declared; but that, if the rate of exchange still continued at the low point to which it had then fallen, they could not hold out hopes of any further advance in the immediate future. Unfortunately, not only had the rate of exchange not improved, but a further serious decline in the sterling value of the dollar had taken place since that period, causing the loss on exchange to be £341 in excess of that for the previous half year. Rent, rates, and taxes had increased by £113; and salaries showed an advance of £135. These items, together amounting to £589, had materially decreased the profit of the half year, which otherwise would have admitted of the payment of a dividend at the same rate as that declared at the last meeting. He need scarcely remark that the increase in these items was unavoidable, and entirely beyond the control of the Directors. Then, with regard to the accounts for which their Manager (Mr. H. W. Smith) was responsible, it would be noticed that there was an advance of £358 in the coal carbonized, notwithstanding that it had cost 1s. per ton less than in the previous six months. Wages had also increased to the amount of £317; but a great portion of this might be accounted for by the labour incurred in the extension of mains and in sinking a well on the works, to enable the Company as far as possible to reduce the cost of their water supply. On the other hand, they had an increase of £204 in the gas and meter rental; and the additional profit on residuals was £439. Considering the great depression in trade at Singapore and the numerous failures they were constantly hearing of, he considered these increases were fairly satisfactory. In conclusion, he said he had now only to express the regret of the Directors that the amount available for dividend was so small, and perhaps it might have been more advisable to pass the dividend, and carry forward the unappropriated balance to the next account. But, as the dividend, small as it was, had been fully earned, they considered it now became the property of the shareholders; and it was quite in their hands, and for them to say how it should be disposed of. He would now call upon his colleagues, Mr. Spencer and Mr. Green, to make a few remarks upon this and other points.

The DEPUTY-CHAIRMAN (Mr. S. Spencer) remarked that, if it had not been for the loss on exchange, the Directors would have been in a position to pay a dividend of 10 or 11 per cent.; but, as long as this went on, it was absolutely impossible to recover the ground that had been lost. Something like £3800 had been sent over; and the loss of £2278 during the half year was rather more than 50 per cent. of that amount.

Mr. B. GREEN remarked that there was one thing the shareholders should consider. The Company had no working capital; and in the face of the serious loss on exchange, it was questionable whether it would not be better to carry the balance forward, instead of paying a dividend. He believed it was the unanimous opinion of the Directors that it would be so. He might say that the loss on exchange was equal to 7 per cent. of the paid-up capital; and it was really a very serious matter. But, of course, as the Chairman had said, the dividend proposed had been earned; and it was for the shareholders to say whether it should not be paid. On the other side of the balance-sheet, the gas and meter rental showed that the business was improving; and that the residuals and fittings had been sold at good prices.

Mr. W. T. BATTEN, the Consulting Engineer (who, it will be remembered, has only lately returned from Singapore) expressed the opinion that things appeared to be much more serious than they really were; and also that, if the Directors had money in hand, they would be able to carry on the concern more advantageously from year to year.

The CHAIRMAN, in reply to questions, stated that they had debenture bonds falling due two or three months hence; and probably some of them would require to be paid off. With regard to the item "Oriental Bank, £300," of that they had already received £110, and a further £55 was due next month. He believed that they would receive the whole of that amount, as £250 had already been written off the amount of the Bank's original indebtedness to the Company. It was pointed out that wages for the six months amounted to £1283, and salaries and collectors' commission to £1670; and, having been asked whether some more economical method could not be devised for collecting the accounts, the Chairman replied that they had urged upon Mr. Smith the desirability, in the interests of the Company, of keeping down the expenditure to the utmost extent, and to effect economies wherever possible.

Mr. ROBINS pointed out that the rate of exchange was likely to go even lower than at present; and it would not take much to put the Company on the "wrong side of the hedge." The dollar was worth nominally 4s. 6d.; but they were now receiving only something like 50 per cent. of that. The price of gas, he understood, was 7s. 5d. per 1000 cubic feet; so that really they were only getting rather more than 3s. 6d. In his opinion, they were working too cheaply, and ought to raise the price. They had a sum of £474 in the accounts for discount for prompt payment and allowances; and it would be very nice if they had that sum in their hands at the present moment.

The CHAIRMAN remarked that Mr. Robins was somewhat mistaken, and that the price of gas per 1000 feet was 7s. 5d. net, after allowing for loss on exchange and discount. The discount of 10 per cent. was first allowed some two or three years ago; and it involved nearly £1000 a year.

This discount was advocated by their late Manager; and it was owing to his repeated representations that it was desirable to reduce the price in this way, that the Directors granted it. It had not, however, resulted in a great increase of business.

Mr. BATTEN observed that he honestly believed; if they had not allowed the discount, they would now have been in even a worse position. Had they not taken this step when they did—the price of oil being then very low—in his opinion they would have lost a considerable portion of their business. It was also of great assistance to them in collecting the accounts.

Mr. DYER was of opinion that there was nothing to be alarmed at in the position of the Company; and he spoke strongly in favour of allowing the amount available for dividend to remain in the hands of the Directors.

Mr. BENSON commented upon one or two items in the accounts; and he also was of opinion that, if the shareholders would forego their dividend, the Directors would be placed in a better position.

Mr. R. G. RICE, referring to the subject of the reduction of expenses at Singapore, stated that he knew Mr. Smith when in England very well; and he always regarded him as a very strict economist. He considered that the question of increasing the price was one which should be left to the Directors; and, speaking for himself, he should feel disposed not to pay a dividend on this occasion.

Mr. T. GUYATT said that, as one of the Auditors, he recently met the Chairman; and he then expressed the opinion that, looking at the position of the Company, it was a pity a dividend should be paid. He thought so still. The amount was really so small to the individual shareholder, and so considerable to the Company, that he strongly recommended that the dividend should not be declared. His co-Auditor (Mr. Magnus Ohren) was unfortunately ill; but, if he had been present, he was sure he would have supported this view.

Mr. GREEN explained, with reference to the question of salaries, that they were not paid in sterling but in currency; and therefore the actual salaries were not so large as represented by the accounts.

On the proposition of Mr. DYER, seconded by Mr. GUYATT, a resolution was then passed, adopting the report and balance-sheet, excepting the clause in the former recommending the payment of a dividend at the rate of 2 per cent. per annum, and carrying the available balance forward to next half-year's accounts.

The retiring Directors (Messrs. Foreman and Spencer) and the Auditors (Messrs. Ohren and Guyatt) were unanimously re-elected.

The usual complimentary votes were passed to the Chairman and Directors and to the various officers; and the proceedings terminated.

Malvern Local Board Gas-Works.—Mr. F. L. Ramsden, of Burton-on-Trent, having recently inspected the Malvern Local Board Gas-Works, has advised the construction of a bench of generator retort-settings, at an estimated cost of £1200. The Board last Tuesday adopted the recommendation.

Water-Works for Millbrook.—In April last year, we reported that a scheme for the water supply of Millbrook had been proposed, the estimate for which was £3850. The plans have since been amended; and the alterations will bring the expenditure up to £5295. An application to the Local Government Board by the Sanitary Authority of the Rural District of St. Germans for their sanction to the borrowing of this sum has formed the subject of an inquiry by Colonel Hasted.

The Dispute over the Laying of a Water-Main at Chesterfield.—At last Tuesday's meeting of the Chesterfield Corporation, the minutes were submitted of a special meeting of the whole Council, held to consider the refusal of the Water and Gas Company to supply the lodge in the Queen's Park with water, and the fact that they had prevented by force the Corporation men making the connection (see *ante*, p. 741). Alderman Wood moved that the minutes be confirmed, with the exception of the one recommending that the dispute as to the manner in which the pipe should be made to communicate with the Company's main be referred to two justices. He thought if the Corporation took action against the Company, they would only make matters worse than they were. Mr. Spooner did not think the Corporation had a good case, and added that it was through the officiousness of the Chairman of the Parks Committee that the matter had been brought forward. Mr. Locke remarked there was no such thing as a certified plumber in Chesterfield, he believed; and yet the Water Company seemed to make that distinction between workmen. The Parks Committee appeared to have a good case; and he thought, in the interests of the borough, they should take up this matter, and carry it to a decision. Mr. Moffatt considered they should fight the matter; the town being sick and disgusted with the humbug at the water-works. Five only voted for the amendment, and the minutes were then confirmed.

Rochdale Corporation Gas and Water Departments.—The abstract of accounts of the Rochdale Corporation for the past year has been issued by the Borough Treasurer. The figures relating to the gas-works show that, notwithstanding the recent stoppage of the mills, the amount of gas which went out of the works was 4,500,000 cubic feet more than in the previous year; but the total gas registered was only £184 more in value than in the preceding year. The apparent discrepancy may perhaps be accounted for by the fact that there has been a great increase in gas consumed for cooking and manufacturing purposes, which is supplied at 2s. per 1000 cubic feet; while there may have been a decrease in the gas used for lighting, which is charged for at a higher rate. The income from residuals exhibits a falling off even from the low total of the previous year. More has been received for coke; but much less for sulphate and the other bye-products. The actual cost of coal and cannel is £24,846, as against £25,739 in the year before; but the saving is more than lost in increased expenses on other items—cost of purification, repairs to retorts, &c.—and the net result of the year's working is a profit of £4289, or £257 less than last year. It is many years since the profits were so small. As to the water undertaking, the ordinary domestic water-rental shows an increase of about £400; but the receipts for water supplied by meter are £300 less on the year. The net deficiency on the twelvemonth is £7724, as against £7763 in the previous year.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The proposal has been made in the Perth Gas Commission, that means be taken to reduce the original debt of the Commission by paying off the annuities. A motion to that effect was made in the Commission on Monday, by Mr. Cuthbert, who pointed out that up till now not a single penny had been paid towards the original cost of the gas-works. Treasurer Dewar followed up this statement with the remark that the gas-works cost in the first place £100,000, and that the annual interest was £300. He held it to be a most exaggerated fiction to have the gas-works standing in their books at £100,000. The Commissioners have certainly been dilatory in freeing the undertaking of debt. There are, of course, local considerations which govern every case; but a general rule, which may be applied in all instances, is that the cost of an undertaking should be written down as speedily as possible. Mr. Cuthbert, however, painted the Commission blacker than is warranted, when he said they had repaid nothing. They are, in point of fact, engaged in repaying their last loan of £18,000, contracted for extensions, at the rate of £1000 a year. Any movement for the reduction of the indebtedness of the Commission is worthy of consideration, because it cannot be many years before something will require to be done to give relief to the works. They are badly situated—being in the midst of a densely peopled district, on which account it is not advisable to engage in any works which give off offensive odours. In addition to this, there is no room for any expansion. Mr. Whimster recently introduced oxide purification; but there is no space in the works for revivifying the oxide, and it is heaped up against a wall inside a shed which is open at one side. Then the works have no railway communication; and they are so situated that to get a railway into them would be a costly undertaking. It will be necessary, or at least advisable, before long to begin the manufacture of gas somewhere else, and probably to close the present works. There is therefore need for the capital account being reduced; and if Mr. Cuthbert's motion, which was sent to a Committee to consider, should lead the Commissioners in that direction, he will have rendered the citizens a service.

The Perth Gas Commissioners have settled their coal contracts for the year at a reduction in price of 3s. 9d. per ton; the average price being 12s. 6¼d. per ton, against 16s. 3¼d. last year.

I am glad that I exercised caution in my "Notes" of last week, with reference to the Provisional Order which the Corporation of Paisley have applied for, in which they ask for power to borrow £20,000 for the extension of the gas-works. The statement that the Order had been granted was circulated unofficially; and I have now ascertained the facts. A communication was received from what is known as the Scotch Office, in which it was stated that Sir George Trevelyan, the Secretary for Scotland, was willing to issue the Order, subject to the following conditions: (1) That the additional loan should be applied only for future improvements, extensions, and renewals, properly chargeable to capital account; (2) that not less than one month's notice should be given to each magistrate and councillor of any meeting at which it was proposed to raise money for the purposes of the Order; and (3) that no decision to raise money for the purposes of the Order should be operative unless passed by an absolute majority of the Magistrates and Town Council. It was also stated that, if the Magistrates and Town Council were willing to accept the Order with these conditions, a draft Order might be submitted with amendments accordingly. It is certainly a surprise that the Secretary for Scotland should in this manner fly in the face of the gentleman—and that gentleman the Sheriff of the county—whom he had appointed to inquire into the matter. Of course, as I said last week, he is quite entitled to set aside any report which may be made to him; but his conduct is open to the observation that he made a mistake in asking Sheriff Cowan to hold the inquiry. Quite apart from the fact that the Sheriff may have been influenced by local considerations—his residence being in Paisley—a lawyer can know nothing as to the necessities of a gas-works. It is difficult to see why, but the Gas Committee of the Corporation, by seven votes to six, resolved that they would not accept the Provisional Order under the conditions laid down. The Corporation met on Tuesday; and when the matter was laid before them, they agreed to put off consideration of it for a month. I presume the Corporation are indifferent as to whether they get the Order or not. They have abundance of revenue to meet year by year the outlay upon extensions; and their surplus revenue would be better employed on that object than upon general improvements in the town. The borrowing of money to be repaid over a number of years, would but enable the Gas Commissioners to perpetuate the system of making contributions for town improvements. Some of the Commissioners object strongly to that system; and it is probably there that the reason will be found for the reluctance of the Committee to accept the offer which Sir George Trevelyan has gone out of his way to make.

"More of the Old, Old Story" is the heading which a local newspaper gives to its report of a meeting of the Dunbar Gas Commissioners held on Wednesday. The meeting was, indeed, as so many have been, quite a scandal. When public men descend to speak of statements made by their colleagues as "falsehoods" there cannot be much of a sense of honour left among them. On this occasion, the disturbance arose over the old question of the coal contracts. Nothing was accomplished upon that subject, which is not at all unusual. The Commissioners, however, did one piece of business; they resolved to defer consideration of the subject of the introduction of oil-gas plant. This resolution is not to be wondered at, when the disorganized state of the Commission is considered.

In Dundee, notwithstanding all the horn-blowing there has been over the introduction of the electric light by the Gas Commission, there are only four arc lamps on the streets. This is not a very large adventure, certainly; but small as it is, it has already been the subject of grumbling on account of the cost. From March 15 to April 30, the charge made upon the Police Commission by the Gas Commission for current supplied to these four lamps was over £17. Mr. Smith took exception to the amount at the Police Commission meeting on Monday; and said that, at the rate which was agreed upon—£25 a year for each

lamp—the charge should have been about £12. An attempt was made to convince Mr. Smith that the £25 a year was only an approximate estimate; but he was not to be put off, and held them to the fact that the price was fixed. Consideration of the subject was postponed for a month, because a large number of the members were absent. Is there an attempt here to perpetrate the trick, which is not unknown elsewhere, of making the electric lighting installation pay by throwing as much as possible of it upon the rates at long prices?

A motion was made in the Saltcoats Police Commission this week, that the Corporation should acquire the local gas-works; but it was lost on a division.

Sulphate of ammonia has, following the market or nitrate, fallen to £11 15s. to £12 per ton on spot, and £11 5s. to £11 10s. for forward delivery.

The Imperial standards of weights and measures in the hands of a number of local authorities in Scotland, are being tested in Glasgow at the present time by officials of the Board of Trade. The Glasgow Corporation Weights and Measures Office has been placed at the disposal of the Board of Trade for the purpose.

Scotland is, like the "remaining parts" of the United Kingdom, enjoying most lovely weather. The country never looked prettier than now—the trees being all in full leaf nearly a month before their usual time. There are, however, drawbacks to this delightful state of things; and local authorities who have charge of the water supply of districts, are getting anxious as they see their reservoirs going down at this early period of the season. A gentleman whose duties lead him to take cognizance of the flow of water in streams, informs me to-day that one stream which he measured this week is only running about one-fourth of its usual summer flow; and that there is no reason for this great diminution, except the severe drought. Bailie Archibald was able to give a species of re-assurance to the communities who are served by the Edinburgh and District Water Trust on Thursday, when he stated that "they had yet a supply of water for some months." He did not say how many months; and if it is only for three, then, in the absence of copious rains, a water famine might be looked for before the end of August.

The Falkirk and Larbert Water Trust are making very little progress with their scheme for the reconstruction of the faulty reservoir embankment at Earl's Burn. They recently had a long sitting upon the subject; and some of the members were disposed to go forward with a scheme which they had before them, while others favoured further procedure. The latter carried the day; and I must say I think they are right. The question has now been under consideration for more than a year; and it is difficult to follow all the steps taken, but they stand in something like the following order: When it was found to be necessary, on account of leakage from the reservoir, to do something, the Trustees held back till the result of the dispute between them and the contractors for the construction of the embankment. In June last, when the award of the arbiter was issued, it was found not to be so satisfactory as the Trustees wished. They were only left with about £5000 with which to carry out the reconstruction. Now, apparently, that which has proved to be the chief stumbling block in the way of the Trustees is the estimate given originally by Mr. Gale, of Glasgow, that the embankment would cost £1600. There surely must be a misapprehension on this score; but the Trustees cling to it, and they are staggered by the knowledge that the actual expenditure upon it was about £6000. Successively they then obtained reconstruction schemes from Mr. Watson, of Bradford, to cost £5300; from Messrs. Leslie and Reid, of Edinburgh, to cost £10,000; from Mr. Gale, to cost £7300; and now from Mr. Neilson, the Superintendent of the Trust's property, and Mr. Wilson, of Greenock, to cost £3200. The difference in the estimates is as to the amount of work the different gentlemen consider requires to be done. Messrs. Leslie and Reid, whose estimate is the highest, propose to construct an entirely new embankment a considerable distance below the present one. Mr. Gale proceeded upon the same principle, but on a site nearer the present embankment. Mr. Watson favoured the building of an embankment close to the existing one. The scheme lately under consideration originated with Mr. Neilson, and consisted of several works to improve the faulty embankment. The scheme was submitted to Mr. Wilson, who suggested some alteration upon it. It was on account of the objection having been raised that Mr. Wilson had not been given a free hand, but had merely been asked to report upon Mr. Neilson's scheme, that the subject was again sent back to the Committee. This time the instruction is to get Mr. Wilson to prepare plans for reconstruction for which he would be responsible. Now the Trust are in this position—that both Mr. Watson and Mr. Wilson, the authors of the lower-priced schemes, have stated that they could not become responsible for them. This leaves only the higher-priced schemes of Mr. Gale and Messrs. Leslie and Reid. As it would be folly on the part of the Trust to adopt any scheme which would not be absolutely safe, there should be no difficulty in making up their minds as to which to choose. In a matter of this sort, the cost should be only a secondary consideration. The bursting of a reservoir is so serious a matter that it must be made secure, at whatever cost. This one is leaking at one place at the rate of 54,000 gallons per day. It is high time it was being put to rights. The Trust are angling for a scheme, the cost of which will come within the amount they have in hand. They ought to give that up, and they possibly will in the end; but meanwhile valuable time is being lost. After all, however, there is this to be said in extenuation of the Trustees' delay—that the plan of Mr. Neilson has, they believe, received the approval of Mr. Hawksley. That is certainly important; and, in the face of it, they might be held blameworthy were they to expend more upon the reconstruction than is necessary. The whole of their difficulty seems to narrow itself down to the fact of their having taken counsel with too many advisers.

The New Water Scheme for Newport.—The Borough Surveyor of Newport (Mr. Kirby) has been appointed Engineer of a scheme for obtaining an additional supply of water for the borough, the parliamentary estimate for which was £120,000. As soon as the agreement between Mr. Kirby and the Corporation has been completed, he will send in his resignation of the office of Borough Surveyor.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *May* 13.

Sulphate of Ammonia.—This market maintains its steadiness, all reports to the contrary notwithstanding. Spot parcels remain exceedingly scarce; and all the reported weakness has no foundation in fact. Requirements, in the hope of a decline before the end of the month, are postponed to the latest possible moment; and all the outside ports are requisitioned to keep the demand away from the principal supplying centres. The wonderfully bright weather is reducing the production of gas sulphate more than usual at this season; and, unless the demand ceases altogether, an improvement will again take place. There is meanwhile no change in the quotations, although nitrate is again considerably lower (now 9s. per ton).

LONDON, *May* 13.

Tar Products.—Benzols are again easier, especially 90's. The price for 50's is about 1s. 4d.; and 90's are scarcely worth much more. The inquiry for solvent naphtha is better; and this will probably increase in value. Pitch is not very firm; and the price ranges from 23s. to 24s. Creosote is certainly weak; and the production in Scotland very materially influences the price. Carbolic acid maintains its position, as do also carbolic crystals and cresylic acid. Anthracene is being disposed of at last week's figures; and the demand is rather better. To-day's prices are: Tar, 13s. Pitch, 23s. to 24s. Benzols, 90's, 1s. 4½d.; 50's, 1s. 4d. Solvent naphtha, 1s. 1½d. Toluol, 1s. 4½d. Crude benzol naphtha, 30 per cent., 7d. Creosote, 1d. Creosote salts, 17s. Carbolic acid, 60's, 2s. 4d.; 75's, 2s. 10½d.; crystals, 7½d. Cresol, 1s. 10d. Anthracene, nominal, 30 per cent. "A," 1s. 1d.; "B," 9d.

Sulphate of Ammonia has had a further check; and the price to-day ranges from £11 7s. 6d. to £11 12s. 6d., less 3½ per cent. for early delivery, although forward delivery is somewhat easier.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—The extremely depressed condition of the round coal trade is resulting in a very keen competition for the gas coal contracts that are now coming upon the market. Although for some of the smaller contracts, the tenders sent in by a good many of the Lancashire colliery firms are based pretty much upon last year's figures—averaging something like 9s. to 9s. 3d. per ton for best screened Wigan Arley gas coal at the pit mouth—these prices are quite out of it, as compared with the quotations which some of the large colliery concerns are sending in. With regard to the contract for the supply of gas coal to the Manchester Corporation, it is reported that this has been obtained at considerably under last year's rates. This is borne out by the fact that firms who have only given way 6d. upon the prices they obtained last year, have been too high to secure renewals; and it is stated that the Corporation have been enabled to buy at quite 9d. to 1s., and in some instances 1s. 6d., below the prices they paid last year. Taking other contracts that have so far been placed, the prices have been about 1s. per ton below those ruling last season. With regard to locomotive fuel, there is also a similar giving way. It is exceptional where best Wigan Arley coal is now fetching more than 11s.; while Pemberton four-feet and second qualities of Arley do not average more than 9s. 6d. to 10s.; and common house-fire coals, 7s. 6d. to 8s. per ton. The lower qualities of round coal, suitable for steam and forge purposes, continue a complete drug upon the market; and where sales of any quantity are concerned, prices are so much a matter of arrangement between buyer and seller, that there are practically no fixed quotations—except that common coals can be bought at from 6s. per ton upwards, at the pit mouth. Steam coals are obtainable, delivered at the ports on the Mersey, at from 7s. 6d. to 8s. per ton; and contracts have in some cases been placed at 1s. to 1s. 6d. per ton below the prices obtained last year. The depressed state of the round coal trade, and the consequent restricted production of slack, is necessarily causing rather a scarcity of supplies of engine fuel; and for these there is a pressure of demand, with a hardening tendency—prices, in many cases, having been advanced 3d. to 6d. per ton. Burgy now averages 6s. 6d. to 6s. 9d.; best slack, 5s. 3d. to 5s. 9d.; medium sorts, 4s. 6d. to 4s. 9d.; and common, about 4s. per ton at the pit mouth.

Northern Coal Trade.—There is an increased demand for certain kinds of coal—the shipments to the Baltic ports having now begun in earnest. Best Northumbrian steam coals are firm, at about 8s. 9d. per ton f.o.b.; and as the collieries have generally now good orders in hand, there is the probability of an increase in the price in one or two instances. Second-class steam coals are not quite in such full demand; and the price varies from 8s. to 8s. 3d. per ton. Small steam coals are steady, at from 3s. 6d. to 3s. 9d. per ton. Manufacturing coals are steady, with a fair demand; but the price keeps low. In gas coals, the local consumption is about at its lowest; but there are larger shipments being made for export. The price of gas coals now varies from 6s. to 6s. 6d. per ton f.o.b.; but the contracts that are running are in several instances considerably below this price. Coke is rather steadier, in anticipation of one or two additional furnaces being put into blast. From 13s. to 14s. per ton is the general quotation for best Durham coke. Gas coke is unaltered in price, or in the extent of the demand, during the last few days.

Scotch Coal Trade.—Continued depression must be reported from Scotland. Except for ell coal, dross, and nuts, the demand is very slack; and prices are very difficult to maintain. Coal for gas purposes is being inquired after; but purchasers are more inclined to pick and choose than they have been for some time, with the result that the better varieties are dragging in a way that the holders of them could not have dreamt of two years ago. The reductions in some cases equal 25 per cent. In the pits, work is very scarce, many of them being only able to give half time to their men. The quotations are: Main, 5s. 9d.; ell, 6s. 9d. to 7s.; splint, 6s. to 6s. 3d.; and steam, 7s. 9d. per ton f.o.b. Glasgow. The shipments for the past week were 152,639

tons—a decrease of 5911 tons upon the preceding six days, and of 22,118 tons compared with the corresponding week of last year. For the year to date, the shipments have been 2,101,449 tons—a decrease compared with the corresponding period of last year of 188,500 tons.

Electric Lighting at Newport.—Professor Robinson has been called in to advise the Newport Corporation as to lighting the thoroughfares by electricity. His estimate for installation for the six principal streets in the centre of the town is £30,560; and the annual cost of maintenance, £5650. For this sum 4500 lamps of 16-candle power could be provided.

The London County Council (General Powers) Bill.—On the motion for the third reading of this Bill in the House of Commons last Tuesday, Mr. Kimber moved, as an amendment, to recommit the Bill to the former Committee, with an instruction to them so to amend clause 15 as to "specify the subject-matters or objects upon which the London County Council are to be at liberty to expend the £10,000 a year therein mentioned." Mr. J. Rowlands opposed the amendment; and said if the matter were referred back, the Committee would very likely repeat the recommendation. Sir J. Lubbock also opposed the amendment. He said he should be greatly surprised if the Council spent the £10,000 allotted to them under the Bill. The amendment was withdrawn.

New Reservoir and Filter-Beds for Bideford.—In a few weeks, a second storeage reservoir (having a capacity of about 10,000,000 gallons) will be completed at Bideford, and will bring the storeage accommodation up to something like 23,500,000 gallons. The new reservoir covers a superficial area of about 4 acres; and the embankment is 35 feet in height, and 246 feet in length—the width at the bottom being 200 feet, and at the top 15 feet. In the centre is a puddle wall 16 feet in width at the base, and 5 feet at the top; with a depth of 46 feet. This enters the rock to a depth of 11 feet. The cost of the reservoir will reach £5000; and £300 has in addition been expended upon the old one. The land cost £500, besides which the Town Council contracted to construct a road, which will probably run the amount up to about £1000. They have also decided that four filter-beds shall be constructed; and they are much needed. These will be each 30 feet square, and will probably cost £1000. Mr. Baldwin Latham is the Engineer of the works, which are being constructed by Messrs. Perrin and Long, of Sutton and Reading.

Bahia Gas Company, Limited.—The working of this Company during the half year ending on Dec. 31 last resulted in a profit of £6704, which, added to the amount brought forward (£3852), makes the sum of £10,557, out of which the Directors recommend the usual dividends on the preference shares and a dividend at the rate of 8 per cent. per annum (free of income-tax) on the ordinary shares. This will absorb £6225, and leave £4332 to be carried forward. As regards the Company's concession, nothing permanent has been arranged with the authorities in Bahia. On Feb. 9 (when the prolongation in force at the shareholders' meeting in November expired) the Company's Manager agreed to a further prolongation for six months from that date, with a proviso that the term is "to be extended to a further six months certain if the Government do not advise the Company to the contrary 90 days previous to the expiration of the first six months." While still feeling that the Company are not being fairly dealt with by the Government in this matter, the Directors decided not to refuse to continue the lighting for another short period.

Failure of the Electric Light at the House of Commons.—Shortly after nine o'clock on Monday evening last week, great inconvenience was caused to the members, officials, and representatives of the Press at St. Stephen's by the sudden failure of the electric light. The Legislative Chamber still depends for its illumination upon gas; consequently the proceedings were not interrupted. The central hall, the members' lobby, the corridors, smoking-rooms, and dining-rooms, and the suite of rooms devoted to the use of the reporters, were, however, for some minutes plunged in darkness; and confusion necessarily resulted. Last Thursday, Sir M. Stewart questioned the First Commissioner of Works on the subject; asking whether the failure was the result of any defect of the apparatus within the precincts of the House, or was due to any default on the part of the Company supplying the light. Mr. Shaw-Lefevre explained that the failure occurred in the case only of the lights furnished by the Westminster Electric Supply Company, and not in those connected with engines in the House. It was due to the melting by the electric current of one of the main safety fuses at the junction of the Company's main cables with a main in the building. The current did not appear to have been abnormally strong. The fuse, therefore, which was originally supplied must have been either too weak when put in, or have been weakened by use. It was now proposed to replace it by one with a greater fusing margin.

Liverpool and the Water Supply of Out-Districts.—Mr. Arnold Taylor, one of the Inspectors of the Local Government Board, held an inquiry at Liverpool last Tuesday, with reference to an application that had been made for a Provisional Order to enable the Corporation to supply water to the district of Shevington. The Deputy Town Clerk (Mr. H. E. Clare) explained that Shevington was really within the area of the Manchester supply as provided for in the Thirlmere Water-Works Act; but it was more convenient for the water to be furnished by the Liverpool Corporation, the cost being less and the facilities of supply greater. However, before Liverpool could proceed in the matter, it was necessary for a Provisional Order to be issued, under section 303 of the Public Health Act, 1887, for the amendment of section 12 of the Liverpool Water-Works and Improvement Act, 1887, so as to remove, so far as related to the township of Shevington, any restriction placed upon the supply of water; to enable the Corporation to enter into agreements with any central authority within the township as to the supply of water; and to enable them to carry to the credit of the water account all moneys received by them in respect of the supply of water to Shevington. Mr. Talbot, as the representative of the Manchester Corporation, and the representatives of the Standish Local Authority and Shevington Parochial Committee expressed their approval of the proposals. A draft Provisional Order was then agreed upon, and handed to the Inspector.

Workington Corporation Gas-Works.—The result of the past year's operations of the Workington Corporation Gas Department is a profit of £1263. The quantity of coal carbonized was 6189 tons, and cannel 190 tons. The gas produced per ton was 8511 cubic feet; and the wages averaged 6·363d. per 1000 feet. The price of gas for domestic purposes is 2s. 6d.; and the public lighting is charged at the rate of £2 per lamp.

The Drought and the Manchester Water Supply.—At the monthly meeting of the Manchester City Council last Wednesday, Alderman Sir John Harwood stated that there was only a supply of water in the Manchester reservoirs for 90 days; and the greatest economy must be practised by the inhabitants unless rain fell very soon. Manchester uses 24,250,000 gallons per diem. The supply of spring water, which is usually from 16,000,000 to 20,000,000 gallons per day, has gone down to 3,000,000 gallons.

The Public Lighting of Kensington.—According to the last annual report of the Lighting Engineer for St. Mary Abbotts, Kensington (Mr. P. Monson), the number of public lamps in use on March 25, 1892, was 4343, of which 4298 consumed 4·5 cubic feet of gas per hour. Of the first-named total, 3703 were placed upon posts, 573 were bracket lamps, 22 were urinal lamps, and 45 were special lamps (fixed upon refuges and at wide crossings), consuming from 10 to 30 cubic feet of gas per hour. There were 182 lamps run against or otherwise broken or injured; and a sum of £52 12s. 9d. was recovered from persons proved to have caused the damage. The lighting rate was 1¾d. in the pound for the year. Mr. Monson refers to the use of carburine for enriching gas. In the course of his remarks, he states that during the winter of 1891–2 he had many opportunities of seeing and examining pipes where there was a defective supply of gas; but in no case could he find that the complaint was caused by the use of carburine. He pointed out that many methods have been tried for enriching gas in bulk; but, after being stored in holders, or conveyed to a distance in pipes, or possibly from a reduction in temperature, the carburetting oil or spirit separated from the gas, and frequently resulted in stoppages.

A Disputed Gas Question at Bradford.—Last Thursday, an important meeting of gas consumers in the Allerton district of the borough of Bradford was held, for the purpose of considering a grievance which exists in the locality respecting the supply of gas. At the present time, the Allerton township is provided with gas by the Clayton Gas Company, who charge 3s. 4d. per 1000 cubic feet, as against 2s. 3d. charged by the Corporation in the other parts of the borough. It was an understanding in the district that, when the township was incorporated, it should be placed on an equal footing with the rest of the borough; but in regard to the gas charge nothing has been altered, though repeated attempts have been made both by the residents and the Corporation to effect a change. At Thursday's meeting it was stated that the Corporation owed it as a duty to the residents to make good, by allowing a rebate on rates, the extra price paid for gas; and it was suggested that the residents should, in order to force public attention to their grievance, combine in deducting the extra gas charge from their rates. Another suggestion was made that the principal gas consumers should combine in forming a limited company to supply their own gas; and thereby bring pressure to bear upon the Clayton Gas Company. Eventually it was decided to hold another meeting at an early date, to take practical steps towards remedying the grievance complained of.

Electric Lighting at Blackpool.—The Electrical Engineer of the Blackpool Corporation (Mr. W. Chew) has submitted to the Gas Committee his thirteenth annual report on the working of the two electric light stations under his charge. He expresses his pleasure that the working expenses have not reached the estimated amount, and that there will be a surplus of about £70 to the good. As the Corporation have for many years gone on with a closed capital account, and no new work was carried out, the working cost may be taken as that of an average year; and on this basis, the cost of the supply per Board of Trade unit can be arrived at. Mr. Chew made an analysis, on the lines adopted by the new central stations now at work in the country. Taking the returns for 1892 of the nine leading London and provincial concerns, he finds the highest cost per unit for working is 8·92d.; the lowest, 3·43d.; while the average is 4·81d. To this must be added something for dividend. The cost of the supply at Blackpool was 4·46d.; but this is subject to a further reduction of 1d. per unit from sundry receipts—making the net cost to the Corporation 3·46d. per unit. With regard to the relative demand for private and public lighting, the number of private lights in use is 18 per cent. of the total; while the private consumption is only 5·25 per cent. of the year's output. The relative demand in June is one-third that in December; there being little private lighting in the latter month. The output of a large town in the neighbourhood in June is just one-eighth that in January.

Buenos Ayres Water Supply and Drainage Company, Limited.—A general meeting of the holders of 6 per cent. preference shares of the above Company was held last Tuesday, at Winchester House, E.C., under the presidency of Mr. H. R. Grenfell. The Chairman said the meeting was called under the impression that it would be wiser to get the works finished on the lines of the Medici arrangement. But since the advertisement was sent out a total revolution had occurred along the whole line of the negotiations of the Argentine debt; and therefore, instead of asking the shareholders to agree specially to the terms of the old agreement, what the Liquidators wished the meeting to do was to authorize them, without any further explanations of the particular state of the correspondence and of the meetings of the Argentine Committee—which, he confessed, at the moment he could not give them—to use their best endeavours to make a final bargain, which they could submit to the preference shareholders. They asked for a completely free hand, without which it would be extremely difficult for them to continue the negotiations. He therefore moved—"That the Liquidators be authorized to take such steps as they may deem expedient for expediting the delivery of the bonds to which the Company is entitled under the rescission contract, and for the settlement of all outstanding questions." Mr. G. W. Drabble seconded the motion, and it was agreed to without discussion.

Liverpool Gas-Fittings Company.—The annual meeting of this Company was held last Wednesday. The report, dealing with the twelve months' work ending March 31 last, stated that the net profit was £1591, which, with £581 brought forward, left £2172 to the credit of profit and loss. The Directors recommended a dividend at the rate of 10 per cent., with a bonus of 1s. per share (free of income-tax), leaving a balance of £672 to be carried to the next accounts. The report was adopted.

Reduction in the Price of Gas in Toronto.—We learn from the General Manager and Secretary of the Toronto Consumers' Gas Company (Mr. W. H. Pearson) that the price of gas has been reduced, as from the 1st of April, as follows: To consumers of 200,000 cubic feet and under per annum, from $1·12½ to $1·05 per 1000 cubic feet; over 200,000 and up to 500,000 cubic feet per annum, $1·05 to $1; over 500,000 cubic feet per annum, from $1 to 90c. For gas-stoves, engines, &c., supplied through separate meters, from $1 to 90c. An extra discount to consumers of upwards of 200,000 cubic feet of gas per annum will as usual be allowed at the end of each year, on the 30th of September. The Directors of the Company claim that, with trifling exceptions, these are lower rates than those of any gas company in America, and also that the illuminating power of the gas averages more than 21 candles, as compared with 17½ candles when the last reduction was made.

Electric Lighting for Kidderminster.—Mr. A. Bromley Holmes, of Liverpool, has submitted a report to the Kidderminster Town Council on the subject of electric lighting. He proposes that they should put down a plant capable of supplying 3000 16-candle incandescent lamps (the buildings being so arranged as to admit of extension) at an approximate cost of £15,000. He candidly admits that, taking into consideration the moderate price charged for gas in the town, as well as the nature of the area of supply, at first there will not be a large demand for electric light, as the cost would be at least double that of gas. He holds out the hope, however, that, when the incandescent lamp patent expires in November next, much cheaper lamps of higher efficiency will be obtainable; and that the time is probably not far distant when the electric light will compete with gas at equal prices. With the view of judging whether the demand for electric lighting will justify the Council in proceeding in the matter, the Electric Lighting Committee are going to send a circular to all probable consumers, inquiring whether they are prepared to accept a supply of electricity at an estimated cost of 6d. per Board of Trade unit, or equal to 5s. per 1000 cubic feet of gas.

Totnes and Bridgetown Gas Company, Limited.—At the annual general meeting of this Company on the 1st inst., the Directors, in their report, stated that the working in the year ending March 25 showed a substantial balance, that they proposed to recommend the usual dividend of 10s. per share, and that they had voted a sum of £45 to the reserve and depreciation fund. They also remarked that the manufacture of sulphate of ammonia had been a decided success; and that, on account of the continued low price of coal, they purposed reducing the charge for gas from midsummer next to 3s. 6d. per 1000 cubic feet. Mr. G. Mitchell moved the adoption of the report. Referring to the sulphate plant, he said its original cost was £275; labour, &c., had cost £56; while the material already disposed of amounted to £89—a return of 11½ per cent. on the outlay. He thought this result was the more satisfactory as this was the first year's working, and the price of sulphate had lately been lower than for a long time. Mr. Rees said he considered it unnecessary to have so large a reserve fund, as the Company had power to call up debenture stock at 4 per cent.; and he moved an amendment that a bonus of 2s. per share should be paid, in addition to the dividend. It was pointed out that this would cost £100, and the proposed reduction in price a similar amount. However, the amendment was carried. The meeting closed with the usual complimentary votes, which included one to the Secretary and Manager (Mr. S. Samuel), and the staff under him, for the able and conscientious way in which they had done their work.

Pathogenic Bacteria in Drinking Water.—The *British Medical Journal* says: "A second report to the Water Research Committee of the Royal Society has been drawn up by Professors Percy F. Frankland and H. Marshall Ward. It deals chiefly with the manner in which the vitality of pathogenic bacteria is affected by the presence of non-pathogenic or saprophytic forms. *Bacillus anthracis*, being one of the hardiest forms of pathogenic organisms when in the spore condition, was taken as a type. One of the most interesting results elicited is the effect of sunshine in destroying spores. In the dark, and at moderate temperatures, the spores of anthrax retain their powers of infection for many months in any of the waters experimented with, fresh or sterilized. But in direct sunlight the spores undergo rapid destruction; and it has been definitely proved that this destruction is directly due to the light rays, especially at the blue end of the spectrum, and not either to a rise of temperature or to any action of the solar rays on the medium. Moreover, the experiments prove that the bacteria spores are really killed, and not merely retarded in development. A great difference, however, was observed in the behaviour of spores according as they were introduced into sterilized or into unsterilized water. Infected sterilized waters, after standing for upwards of seven months, were invariably fatal to the animals into which they were inoculated, whether they were preserved in absolute darkness or in diffused daylight. Direct sunshine was, however, rapidly fatal to anthrax spores in these waters within 84 hours. In unsterilized waters, the results were different. The spores degenerated; and, although by special methods they could be revived, they were no longer recognizable by ordinary cultivation methods after the lapse of a few days. To summarize the results, the authors state generally that there is one natural agency at least which destroys anthrax spores in surface water—viz., the action of direct sunshine. Whether or not the activity of water bacteria may be added as a second bactericidal agent, is not definitely determined; but, of the two, sunshine is by far the more rapid and potent. In no case does the evidence support the view that the *bacillus anthracis* can live and multiply like a water bacterium in ordinary waters."

The Electric Lighting Scheme of the Worcester Corporation.—At a meeting of the Worcester Town Council held on the 25th ult., the subject of the Corporation's electric lighting scheme came up, on a recommendation of the Watch and Lighting Committee that the Council's resolution of Dec. 6 last should be amended so as to permit of application being made to the Local Government Board for a loan of an additional sum of £9000 for the electric lighting station. The Mayor (Mr. A. P. Allsopp, M.P.), in moving the adoption of the recommendation, pointed out that Mr. W. H. Preece originally thought that £2000 would be sufficient to erect suitable buildings for the station; but since then they had had to go to another site. This was a very expensive one; for the substructure would cost almost as much as the superstructure. The Surveyor's estimate for the building was about £10,000; in addition to which there would be extra charges in connection with the engineers and clerk of the works, which they might roughly estimate at £1000—making a total cost of £11,000. Towards this they had already asked for £2000; and now they wanted to apply for the balance of £9000. How the error was committed, that they could put up a building suitable for their purposes for £2000, he hardly liked to imagine. Mr. Millington suggested that it was possible there might be other inaccuracies, and that the city might find itself landed in a very much larger expenditure than was now anticipated. The Sheriff (Mr. G. H. Williamson) said Mr. Preece's original estimate was £40,000. The tender of the Brush Company for the installation and mains was about £23,000; leaving £17,000 for buildings and contingencies. When they had paid the Brush Company, and put up the proposed buildings at the new site at Powick, they would have expended £34,000; and they would be still £5000 or £6000 below the original figures. In defence of Mr. Preece's estimate of £2000 for the buildings, he pointed out that steam power was then contemplated; while an installation under the control of steam and water, as proposed at Powick, necessitated double the area than for steam alone. Alderman Airey remarked that, although Worcester was one of the best-lighted cities in the kingdom, he did not object to the introduction of the electric light upon proper terms; but if the expense now proposed had been stated at the time when they were asked to adopt the light, he thought it was possible it might have affected the decision of the Council. He contended that the Committee had put before them an incomplete statement. After some further remarks, the recommendation was agreed to.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 879.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	13 Apl.	10½	Alliance & Dublin 10 p. c.	10	17—18	+½	5 16 3
100,000	10	"	7½	Do. 7 p. c	10	12—13	..	5 15 5
300,000	100	3 Jan.	5	Australian (Sydney) 5 % Deb.	100	104—106	..	4 14 2
100,000	20	30 Nov.	8	Bahia, Limited	20	11—12	..	13 6 8
200,000	5	12 May	6¼	Bombay, Limited	5	5¼—6*	..	5 8 4
40,000	5	"	6¼	Do. New	4	3¾—4¼*	..	6 2 6
380,000	Stck.	24 Feb.	11½	Brentford Consolidated	100	216—220	..	5 4 7
180,000	"	"	8½	Do. New	100	168—173	..	4 18 3
220,000	20	15 Mar.	11½	Brighton & Hove Original	20	41—43	..	5 6 11
888,500	Stck.	31 Aug.	5	Bristol	100	104—107	..	4 13 5
320,000	20	13 Apl.	11½	British	20	42—44	..	5 4 7
50,000	10	15 Mar.	11½	Bromley, Ordinary 10 p. c.	10	19—20	..	5 15 0
51,510	10	"	8½	Do. 7 p. c.	10	14½—15½	..	5 9 8
328,750	10	—	—	Buenos Ayres (New) Limited	10	5½—6½	..	—
200,000	100	3 Jan.	6	Do. 6 p. c. Deb.	100	97—100	—½	6 0 0
150,000	20	24 Feb.	8	Cagliari, Limited	20	25—27	..	5 18 6
550,000	Stck.	28 Apl.	12½	Commercial, Old Stock	100	243—248	..	5 0 10
165,000	"	"	9½	Do. New do.	100	182—187	..	5 1 7
160,762	"	15 Dec.	4½	Do. 4½ p. c. Deb. do.	100	127—132	..	3 8 2
800,000	Stck.	15 Dec.	13	Continental Union, Limited	100	234—239	..	5 8 9
200,000	"	"	10	Do. 7 p. c. Pref	100	192—197	..	5 1 6
75,000	Stck.	15 Mar.	10	Crystal Palace District	100	187—192	..	5 4 2
486,090	10	27 Jan.	10	European, Limited	10	21½—22½	..	4 8 11
354,060	10	"	10	Do. Partly paid	7½	15—16	..	4 13 9
5,596,560	Stck.	10 Feb.	12	Gaslight & Coke, A, Ordinary	100	219—223	—1	5 7 7
100,000	"	"	4	Do. B, 4 p. c. max.	100	95—99	..	4 0 10
665,000	"	"	10	Do. C, D, & E, 10 p.c. Pf.	100	263—268	..	3 14 7
30,000	"	"	5	Do. F, 5 p. c. Prf.	100	120—125	..	4 0 0
60,000	"	"	7½	Do. G, 7½ p. c. do.	100	170—175	..	4 5 8
1,300,000	"	"	7	Do. H, 7 p. c. max.	100	169—174	..	4 0 5
463,000	"	"	10	Do. J, 10 p. c. Prf.	100	260—265	..	3 15 6
476,000	"	"	6	Do. K, 6 p. c. Prf.	100	156—160	..	3 15 0
1,061,150	"	15 Dec.	4	Do. 4 p. c. Deb. Stk.	100	124—128	..	3 2 6
294,850	"	"	4½	Do. 4½ p. c. do.	100	130—134	..	3 7 2
908,000	"	"	6	Do. 6 p. c. do	100	169—173	..	3 9 4
3,800,000	Stck.	12 May	12	Imperial Continental	100	223—226*	..	5 6 2
75,000	5	30 Nov.	6	Malta & Mediterranean, Ltd.	5	4½—5	..	6 0 0
560,000	100	4 Apl.	5	Met. of Melbourne, 5p. c. Deb.	100	102—104	—1	4 16 2
541,920	20	16 Nov.	5	Monte Video, Limited	20	13—14	—½	7 2 10
150,000	5	30 Nov.	10	Oriental, Limited	5	7¼—8¼	..	6 1 2
60,000	5	29 Mar.	7	Ottoman, Limited	5	4—4½	..	7 7 4
166,870	10	—	2	Pará Limited	10	2—2½	..	—
420,000	100	2 May	6	People's Gas of Chicago— 1st Mtg. Bds.	100	100—105	..	5 14 3
500,000	100	1 Dec.	6	2nd Do.	100	100—105	..	5 14 3
150,000	10	28 Apl.	5	San Paulo, Limited	10	8½—9½	..	5 5 3
500,000	Stck.	24 Feb.	15½	South Metropolitan, A Stock	100	294—299	..	5 3 8
1,350,000	"	"	12	Do. B do.	100	244—248	..	4 16 9
230,000	"	"	13	Do. C do.	100	245—255	..	5 1 11
750,000	"	13 Jan.	5	Do. 5 p. c. Deb. Stk.	100	148—152	..	3 5 9
60,000	Stck.	15 Mar.	11½	Tottenham & Edm'nton, "A"	100	225—230	..	5 0 0
				WATER COMPANIES.				
744,897	Stck.	30 Dec.	10	Chelsea, Ordinary	100	265—270	..	3 14 1
1,720,252	Stck.	29 Mar.	8	East London, Ordinary	100	212—216	+½	3 14 1
544,440	"	30 Dec.	4½	Do. 4½ p. c. Deb. Stk.	100	142—145	..	3 2 1
700,000	50	15 Dec.	8½	Grand Junction	50	111—114	..	3 14 7
708,000	Stck.	10 Feb.	11	Kent	100	280—285	..	3 17 2
1,043,800	100	30 Dec.	9½	Lambeth, 10 p. c. max.	100	243—248	..	3 16 7
406,200	100	"	7½	Do. 7½ p. c. max.	100	199—204	..	3 14 0
285,000	Stck.	29 Mar.	4	Do. 4 p. c. Deb. Stk.	100	129—132	..	3 0 7
500,000	100	10 Feb.	12½	New River, New Shares	100	329—334	..	3 12 8
1,000,000	Stck.	27 Jan.	4	Do. 4 p. c. Deb. Stk	100	133—137	..	2 18 5
902,300	Stck.	15 Dec.	6½	S'thwk & V'xhall, 10 p. c. max.	100	165—170	..	3 16 5
126,500	100	"	6½	Do. D 7½ p. c. do.	100	145—150	..	4 6 8
1,155,066	Stck.	15 Dec.	10	West Middlesex	100	262—267	..	3 14 11

*Ex Div.

Perpetration of Frauds on Gas Consumers.—At the London County Sessions last Tuesday, Frederick Taylor, 45, a labourer, was indicted for having obtained by false pretences several small sums of money with intent to defraud. The prisoner pleaded guilty. Mr. Travers Humphreys said he was instructed to prosecute on behalf of The Gaslight and Coke Company, in whose employ the prisoner had been as a fitter. He was dismissed for drunkenness; and the offences with which he now stood charged practically commenced this year. When he left the Company's service, he did not deliver up a book containing the names of many of their customers. With the book in his hand, and a bag of tools at his back, he went from house to house to examine the gas-fittings; and in one place he stated that, if the repairs were not completed at once, a terrible explosion would take place. At most of the houses he obtained money under the pretence of wanting certain screws, of which he had run short. He had been to 707 places in London; and there were between 80 and 90 cases against him. When arrested, all he said was: "I should not have done it had I not been starving." He was sentenced to 21 months' hard labour.

The Electric Lighting Installation at Larne.—A letter was read at a meeting of the Larne Town Commissioners on the 27th ult., from the Receiver and Manager of the firm of Messrs. J. E. H. Gordon and Co., Limited, offering the town the electric lighting works for £8000, in cash or town stock. He placed the annual working expenses at £300; and then made the encouraging statement that: "The income is now being increased, and can be largely added to by obtaining private customers. The working expenses will not be much greater than the above-mentioned amount, when the revenue is added to, which I find can be done to a considerable extent." In this view the Commissioners evidently did not concur; for, in discussing the matter, the Chairman (Mr. J. Foster) expressed his conviction that, if they purchased the concern, it would mean an extra tax on the ratepayers of about 1s. in the pound, while Mr. Picken went so far as to say that, if they had the installation as a gift, it would be six years before it paid for itself. Mr. M'Williams agreed that they would be heavy losers if they acquired the works; and he proposed a resolution declining to buy them on the terms named. This was carried.

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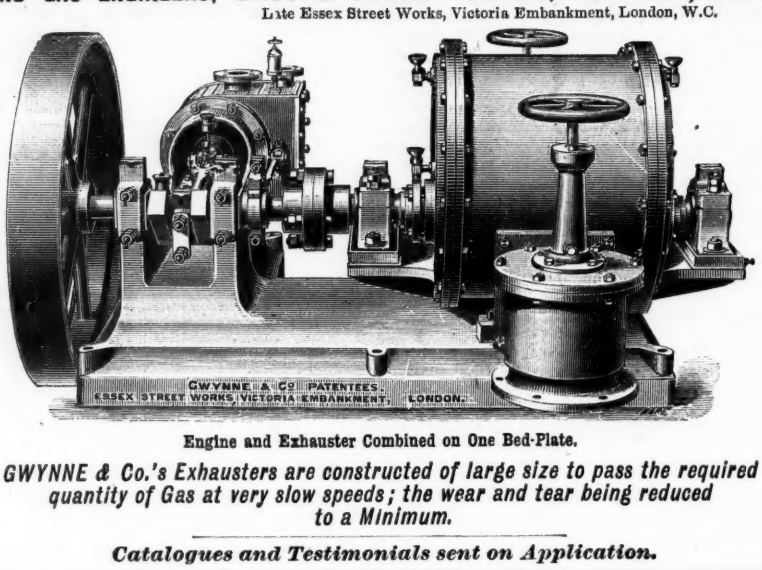

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JOHN ROMANS & SON, EDINBURGH.
Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS AND WATER WORKS.
Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH, / NEWTON GRANGE, NEAR DALKEITH, } SCOTLAND.

PORTER & CO., Gowts Bridge Works,
LINCOLN, Engineers, Ironfounders, and Contractors, for the erection of Gas-Works for Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings, at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.
Telegraphic Address: "PORTER, LINCOLN."

JAMES LAWRIE & CO. supply Best SCOTCH CANNEL COALS, Best FIRE-CLAY RETORTS, BRICKS, TILES, and LUMPS; BOILER SEATING BLOCKS, FLUE COVERS, and SILICA BRICKS for SPECIAL FURNACE WORK; COKE BARROWS, BOGIES, and SMALL WAGONS.
Postal Address: 1, WHITTINGTON AVENUE, E.C.
Telegram Address: "EIRWAL LONDON."

W. C. HOLMES & Co., Huddersfield; AND 80, CANNON STREET, LONDON,
Contractors for Gas-Works complete, Makers of Gasholders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also for Collingwood's Regenerative Retort-Settings.
*** See Advertisement p. III., centre of JOURNAL.
Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

J. & J. BRADDOCK, Globe Meter Works, Oldham.
First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.
Telegraphic Address: "Braddock, Oldham."

TO INVENTORS AND OTHERS.

PATENTS for Inventions Secured and TRADE MARKS REGISTERED throughout the World. Advice on all matters connected with the above. Handbook gratis on application.
J. C. CHAPMAN, C.E., Chartered Patent Agent, 70, Chancery Lane, LONDON.

A WELL-CONDUCTED Youth, about 16 years of age, having just left School, being anxious to obtain employment, would be glad to hear of anything in which his Services could be made available. Is a good French Scholar, both as to speaking and writing, having two Preceptor's Certificates to that effect and a Cambridge Local (Junior), a good Arithmetician, and, age considered, fairly well up in Shorthand and Geometrical Drawing.
References to W. LIVESEY, 76, Palace Chambers, WESTMINSTER.

IRISH BOG ORE OXIDE OF IRON.

GAS PURIFICATION.

BALE & CO., direct Importers from Ireland. Sample and Price on application.
OXIDE PAINT, SULPHURIC ACID, & Chemicals.
120 and 121, NEWGATE STREET, LONDON, E.C.
Telegrams: "BOGORE, LONDON."

OXIDE OF IRON.

FINEST Quality of Natural Bog Ore.
Particulars and price, apply to Mr. T. L. ARCHER, 20, Fennel Street, MANCHESTER.

MESSRS. DEBENHAM, TEWSON, FARMER, and BRIDGEWATER'S MONTHLY LIST of Shops, Show-Rooms, Factories, and Waterside Premises, suitable for the Exhibition and Manufacture of Engineering and other Appliances, may be obtained, free of charge, at their Offices, 80, CHEAPSIDE, E.C.

SADLER AND CO., LIMITED,
MIDDLESBROUGH; ULVERSTON (BARROW); PORTSMOUTH; CARLTON; STOCKTON; 315, St. Vincent Street, GLASGOW; 10, Marsden Street, MANCHESTER; and 85, Water Street, NEW YORK. Tar Distillers, Manufacturers of all TAR PRODUCTS, ALIZARINE and other TAR COLOURS, BICHROMES, OXALIC ACID, ALKALIES, LIQUOR AMMONIA, AMMONIA, SULPHATE, &c.
Head Office: MIDDLESBROUGH. Correspondence invited.

LIQUOR and Tar wanted.
BROTHERTON AND CO., Ammonia and Tar Distillers, LEEDS and WAKEFIELD.

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Chemical Works, LEEDS, specially produce this ACID from BRIMSTONE, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

ROSARIO GAS-WORKS, RIVER PARANA.

WANTED, a competent second Engineer. Salary, £250 per annum and Rooms, first year; passage out and home.

For further particulars, apply, with credentials, to HUGO BROWN AND Co., 18, Alexandra Buildings, 41, Ormond Street, LIVERPOOL.

WANTED, an Assistant Draughtsman in a Gas Engineer's Office, who is thoroughly competent to make Plans for all kinds of Gas Machinery, and who is an accurate estimator of weights.

Apply, with references, to NEWTON, CHAMBERS, AND Co., LIMITED, Thorncliffe Iron-Works, near Sheffield.

WANTED, immediately, by the Llangollen Gas Company, Limited, a WORKING MANAGER. Must have a thorough practical knowledge of Gas Making and its Distribution. One who is a Fitter preferred. Make of Gas, 4 millions a year. House, Light, and Fire provided.

Applications, with testimonials, stating wages required, to be sent in before the 25th inst., and to be addressed to Mr. HARVEY BIRCH, Cherry Tree, LLANGOLLEN.

MERTHYR TYDFIL GAS COMPANY.

WANTED, a young Man, as Assistant CLERK. Must be experienced in the Accounts of a Gas Office.

Applications, in own writing, stating age, experience, and particulars of last employment, and enclosing *copies only* of three recent testimonials, to be endorsed "Assistant Clerk," and addressed to the undersigned not later than Tuesday, the 30th inst. Salary £78 per annum.

JOHN L. COCKER,
Manager and Secretary.

Gas Offices, Gas-Works, Merthyr Tydfil, Glamorganshire, May 13, 1893.

WANTED, one of Gwynne and Co.'s GAS EXHAUSTERS. Engine 15 inches diameter, by 20-inch Stroke. Must be in thorough good order.

Address the BRYMBO STEEL COMPANY, LIMITED, near WREXHAM.

FOR SALE—A perfectly new 20,000 cubic feet per hour EXHAUSTER, with Steam-Engine combined, including Hydraulic Gas Governor, Bye-Pass Valves, and Connections.

For further particulars, apply to Mr. T. G. MARSH, 41, Corporation Street, MANCHESTER.

FOR SALE, the following second-hand GAS PLANT:—

GASHOLDER, 35 ft. by 14 ft.
GASHOLDER and Cast-Iron TANK, 30 ft. by 17 ft.
Four PURIFIERS, 12 ft. square by 4 ft. 6 in. deep.
Cast-Iron SCRUBBER, 26 ft. high by 10 ft. diameter.
CONDENSERS to pass 500,000 cubic feet per diem.
EXHAUSTER to pass 20,000 cubic feet per hour.

Also various other sizes of above or any Gas Plant. Inquiries invited.

Apply to SAML. WHILE, 60, QUEEN VICTORIA ST., E.C.

DOUGLAS (ISLE OF MAN) GASLIGHT COMPANY.

THE Directors of the above Company invite TENDERS for the supply of about 11,000 tons of best screened GAS COAL, to be delivered, on the Quay alongside their Works, between the 1st of August, 1893, and the 31st of July, 1894, in such monthly quantities as may be required.

Tenders (enclosing Analysis of Coal tendered for) to be delivered at the Company's Office, Douglas, not later than Monday, the 29th inst.

The Directors do not bind themselves to accept the lowest or any tender.

CHAS. H. KAY,
Secretary.

May 9, 1893.

BROADSTAIRS GAS COMPANY.

THE Directors of the above Company invite TENDERS for the supply of 2000 tons of good screened GAS COAL, delivered at Broadstairs Station or into Carts at Broadstairs Harbour, in such quantities as the Manager may require between August, 1893, and July, 1894.

Tenders to be sent in not later than Monday, June 5, 1893, addressed to the Chairman of the Company.

The Directors do not bind themselves to accept the lowest or any tender.

Full Particulars can be obtained on application to the undersigned.

W. J. LATCHFORD,
Secretary and Manager.

Broadstairs, May 8, 1893.

CHELMSFORD GASLIGHT AND COKE COMPANY.

TENDERS FOR COALS.

THE Directors of this Company invite TENDERS for the supply of GAS COAL, COBBLES, or NUTS for One Year; the quantity being about 3500 tons.

The Coals, Cobbles, or Nuts must be the best of their respective kinds, freshly wrought, and to be as free as possible from Sulphur, Bats, Bind, and Dirt.

Sealed tenders, specifying the description of Coals, the Seams and the Pit at which they are raised, and stating price per ton delivered free at the Siding of the Great Eastern Railway Company, Chelmsford, or f.o.b. the Company's Ships in the Tyne or elsewhere, must be delivered not later than May 30.

The Directors reserve to themselves the right to decline the lowest or any tender.

Further Information and Forms of Tender may be obtained of the undersigned on application.

EDMUND G. SMITHARD,
Engineer.

Gas-Works, Chelmsford, May 15, 1893.

THE Directors of the Wollaston Gas Company invite TENDERS for the supply of about 300 tons of best GAS COALS, delivered free at L. & N. W. Station, Wellingborough, for Twelve Months from the 30th of June next.

Tenders, stating price per 21 cwt., to be delivered to the Secretary, 55, Oxford Street, Wellingborough, on or before the 22nd inst.

Neither the lowest nor any tender will necessarily be accepted.

COUNTY BOROUGH OF BURNLEY.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Gas Committee of the Corporation of Burnley are prepared to receive TENDERS for the supply of the CANNEL COAL required by them during the Twelve Months ending May 31, 1894.

Approximate quantity required, 3000 tons.

Tenders (stating price delivered into the Tramway Tubs of the Corporation at their Wharf on the Leeds and Liverpool Canal) must be made upon a form to be obtained on application to the undersigned. They must be sealed, and addressed to the Chairman of the Gas Committee, Town Clerk's Office, Town Hall, Burnley, endorsed "Tender for Cannel," and posted not later than Wednesday, the 31st of May, 1893.

By order,
JNO. P. LEATHER,
Gas Engineer.

Gas-Works, Burnley, May 12, 1893.

SUTTON-IN-ASHFIELD LOCAL BOARD.
(GAS DEPARTMENT.)

TO TAR DISTILLERS AND OTHERS.

THE Gas Committee of the Sutton-in- Ashfield Local Board are prepared to receive TENDERS for the purchase of the surplus TAR and AMMONIACAL LIQUOR produced at their Works from July 1, 1893, to June 30, 1894.

Particulars may be obtained on application to the Manager, at the Gas-Works, Sutton-in-Ashfield, Notts.

Tenders, stating price per ton of 20 cwt. at the Works, or at Sutton-in-Ashfield Railway Station, to be addressed to the Clerk to the Local Board, Local Board Offices, Sutton-in-Ashfield, and marked "Tender for Tar and Liquor," so as to arrive not later than Tuesday, the 30th day of May, 1893.

By order,
G. H. HIBBERT,
Clerk to the Committee.

Local Board Offices, Sutton-in-Ashfield, Notts.

SUTTON-IN-ASHFIELD URBAN SANITARY DISTRICT.

EXTENSION OF GAS-WORKS.

THE Sutton-in-Ashfield Local Board invite TENDERS for the execution of the following WORKS:—

Excavating for, and the erection of, a BRICK TANK, 74 feet in diameter and 18 feet deep.
The erection of a COLUMNLESS GASHOLDER.
The erection of a set of Four PURIFIERS, 22 ft. by 10 ft., with Valves, Connections, Lifting Gear, &c., complete.

Plans, Specifications, Quantities, and Form of Tender will be sent by post on application to the Engineer, Mr. C. E. Jones, Chesterfield, as follows: Excavating and Erecting the Tank, &c., One Guinea; Four Purifiers, Connections, &c., One Guinea; and for the Gasholder, on payment of a fee of 7s. 6d. These Fees will be returned to persons *bonâ fide* tendering.

Tenders, sealed and endorsed "Tenders for Gas-Works," should be sent to the Manager of the Gas-Works, Local Board Offices, Sutton-in-Ashfield, on or before Monday, the 29th inst.; and the Local Board do not bind themselves to accept the lowest or any tender.

G. H. HIBBERT,
Clerk to the said Local Board.

Sutton-in-Ashfield, May 5, 1893.

SUTTON-IN-ASHFIELD LOCAL BOARD.
(GAS DEPARTMENT.)

OWING to making Extensions at the above Works, OFFERS are invited for the SALE of the following PLANT:—

One GASHOLDER, 30 feet diameter by 12 feet deep, with Guides, in good order. The same may be seen in use.
12 in. by 12 in. ⊃ HYDRAULIC MAIN for 30 Mouthpieces, DIP and BRIDGE PIPES, &c.

Offers to be sent in to A. CLARKE, Gas-Works, Sutton-in-Ashfield, NOTTS.

GLOUCESTER GASLIGHT COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the above Company invite TENDERS for the supply of 18,000 tons of GAS COAL for One year, from the 1st day of July next, in such monthly quantities as may be required by the Company.

Tenders to state the price delivered at the Midland Railway Wharf, High Orchard, or the Great Western Railway Wharf, Llanthony, Gloucester; or if sent (as preferred) by Water, the price delivered both in Vessel, and at the Gas Company's Wharf on the Gloucester and Berkeley Canal.

Further Particulars and Forms of Tender may be obtained of the Company's Engineer, Mr. R. Morland.

Sealed tenders, endorsed "Tender for Coal," specifying the description and quality of the Coal, to be addressed to the Chairman, Gas Offices, Eastgate Street, Gloucester, and delivered not later than Monday, the 5th day of June next.

The Directors reserve to themselves the right to accept the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any tender.

By order,
WILLIAM E. VINSON,
Secretary.

Gas Offices, Gloucester, May 11, 1893.

TO PIPE FOUNDERS.

THE Directors of the Tynemouth Gas Company are prepared to receive, on or before the 25th inst., TENDERS for the supply and delivery, carriage paid, to their Siding at North Shields, of 68 yards of 24-inch, and 784 yards of 18-inch CAST-IRON SOCKET and SPIGOT PIPES.

Further Particulars from the undersigned.

The Directors do not agree to accept the lowest or any tender.

WM. HARDIE, Jun.,
Engineer.

North Shields, May 10, 1893.

STATION GOVERNOR.

THE Directors of the Tynemouth Gas Company are prepared to receive, on or before the 25th inst., TENDERS for the supply and erection of a 24-inch STATION GOVERNOR, at the Gas-Works, North Shields.

Further Particulars from the undersigned.

The Directors do not agree to accept the lowest or any tender.

WM. HARDIE, Jun.,
Engineer.

North Shields, May, 10 1893.

CROYDON COMMERCIAL GAS AND COKE COMPANY.

SALE BY TENDER OF £5250 FOUR PER CENT. MORTGAGE DEBENTURES,

IN SUMS OF £50 OR MULTIPLES THEREOF, TO BE ISSUED THE 1ST OF JULY, 1893, AND PAID OFF AT PAR ON THE 1ST OF JULY, 1903.

Minimum Price, at the rate of £103 per cent. of the Amount of each Debenture.

THE Directors invite Tenders for the above-mentioned MORTGAGE DEBENTURES, to be sent to me before Eleven o'clock on the Morning of Wednesday, the 31st of May, 1893.

Printed Particulars and Conditions of Tender can be obtained at the Company's Offices, Katharine Street, Croydon.

WILLIAM J. RUSSELL,
Secretary.

May 3, 1893.

CROYDON COMMERCIAL GAS AND COKE COMPANY.

SALE BY TENDER OF 500 ORDINARY SHARES OF £10 EACH.

MINIMUM PRICE, £22 PER SHARE.

THE Directors give notice that they will be prepared to receive, not later than Eleven o'clock on the Morning of Wednesday, the 31st of May, 1893, sealed TENDERS for 500 ORDINARY SHARES of £10 each, to be paid up, in full, on the 30th of June, 1893, and to bear Dividend from that date.

The Dividend paid upon this class of Shares since the 1st of July, 1888, has been at the rate of 11 per cent. per annum.

One Share or any number of the Shares may be tendered for.

Printed Particulars and Conditions of Tender, and Form of Tender, may be obtained at the Offices of the Company, Katharine Street, Croydon.

WILLIAM J. RUSSELL,
Secretary.

April 26, 1893.

BRADFORD CORPORATION WATER-WORKS.

TO CONTRACTORS.

CONTRACT NO. 1.—GOUTHWAITE RESERVOIR. NIDD VALLEY WORKS.

THE Corporation of Bradford invite TENDERS for the construction, and maintenance for Twelve Months after completion, of a large COMPENSATION RESERVOIR and Works connected therewith at Gouthwaite, situate about 2¼ miles from Pateley Bridge.

The Works will comprise:—

1. Masonry Dam, Earth Embankment, Outlet-Valve Towers, Culverts, Bridge of fourteen Spans, Waste Channels, Gauge Basin, and River Walls.
2. The opening and working of Stone Quarry, construction of Tramway Line from Quarry to Embankment, Masonry Bridge, and Works connected therewith.
3. The formation of about 2½ miles of New Roads, including Bridges and Culverts.
4. The erection of about 7½ miles of Boundary and Road Walls, with Entrance Gates and other Works.

The Drawings and Specification of Works may be seen, and Copy of the Specification, with Conditions, Bills of Quantities, and Form of Tender, may be obtained at the Office of Mr. James Watson, M.Inst.C.E. the Corporation Water-Works Engineer, Town Hall, Bradford, on and after Friday, the 12th inst., on payment of Five Guineas, which sum will be returned in full as soon as practicable after the receipt of a *bonâ fide* Tender, with the Bill of Quantities and Schedule fully priced out.

An Assistant Engineer will meet intending Contractors at Stripe Head Farm, Wath, Pateley Bridge, on Friday, the 19th inst., Wednesday, the 24th inst., Tuesday, the 30th inst., and Friday, the 2nd day of June next, each day at One o'clock p.m., to show them over the Site of the Works, the Shafts sunk on the line of the Embankment, and the Quarry, and to supply any other information required.

Sealed tenders, endorsed "Tender for Gouthwaite Reservoir," to be sent to the Town Clerk at the undernamed Office not later than Thursday, the 8th of June next.

An assurance must be given by each Contractor that he pays to the workmen employed by him not less than the minimum standard rate of wages.

The Corporation do not bind themselves to accept the lowest or any tender.

By order,
W. T. M'GOWEN,
Town Clerk.

Town Clerk's Office, Town Hall, Bradford, May 4, 1893.

TENDERS FOR COAL.

THE Directors of the Derby Gaslight and Coke Company are prepared to receive TENDERS for the supply of 40,000 tons of COAL or NUTS.

Particulars may be obtained from the undersigned.

Sealed tenders, endorsed "Tender for Coal," and addressed to the Chairman of the Finance Committee, must be delivered at the Offices of the Company, Friar Gate, on or before Tuesday, the 30th day of May.

RICHARD FISHER,
Secretary.

Gas Office, Derby, May 8, 1893.

GUILDFORD GASLIGHT AND COKE COMPANY.

TO GAS COAL MERCHANTS.

THE Directors of the above Company are prepared to receive TENDERS for the supply of 16,000 to 18,000 tons of GAS COAL, to be delivered free at Guildford Station during the period of Two Years from July 1, 1893, to June 30, 1895, in such quantities and at such times as required.

The Directors reserve the right to accept the whole or any portion of the quantity offered, and do not bind themselves to accept the lowest or any tender.

Tenders to state the name of the Coal offered, to be endorsed "Tender for Coal," and to be sent to Mark Smallpeice, Esq., Chairman of the Gas Company, Guildford, on or before Wednesday, May 31, 1893.

By order,
WILLIAM LONGWORTH,
Secretary.

Gas Offices, Guildford,
May 12, 1893.

TO TAR AND LIQUOR DISTILLERS.

THE Directors of the Guildford Gas-light and Coke Company are prepared to receive TENDERS for their surplus TAR and LIQUOR for the Year ending June 30, 1894.

Quantity of Coal and Cannel carbonized, about 9500 tons.

Tenders to state the price per cask of 40 gallons, and in matter of Liquor to state the price per cask of 5° and upwards. Carriage to and from Railway Station, Guildford, free.

Tenders, properly endorsed, and addressed to the Chairman of Directors, Gas Company, Guildford, must be delivered on or before Wednesday, May 31, 1893.

By order,
WILLIAM LONGWORTH,
Secretary.

Gas Offices, Guildford,
May 11, 1893.

CORPORATION OF LEICESTER.

COAL TENDERS.

THE Gas Committee of the above Cor-poration are prepared to receive TENDERS for the supply of COALS, COBBLES, or NUTS (about 110,000 tons per annum) for One, Two, or Three Years ending May 31.

Particulars and Form of Tender can be obtained on application to the Engineer.

Tenders, addressed to Alderman Lennard, Chairman, and endorsed "Tender for Gas Coal," to be delivered at these Offices not later than Eleven o'clock a.m. on Saturday, the 3rd of June next.

The Committee do not bind themselves to accept the lowest or any tender.

ALFRED COLSON, M.Inst.C.E.,
Engineer and Manager.

Gas Offices, Millstone Lane, Leicester,
May 4, 1893.

TENDERS FOR GAS COALS.

THE Directors of the Tonbridge Gas Company are prepared to receive TENDERS for the supply of 3500 tons of the best Screened GAS COAL or NUTS, from the Districts of Durham or South Yorkshire, to be delivered at such time and in such quantities as may be required between the 1st day of July next and the 31st day of May, 1894, either in Trucks at the Tonbridge Station of the S.E.R., or by Barge alongside the Gas Company's Wharf, which abuts the River Medway.

Parties tendering must give full particulars (with analysis) of the Coal they propose to supply, and name the Pit from which the same will be raised.

Terms and Conditions may be obtained on application to the undersigned.

Sealed tenders to be sent in not later than the 25th inst., addressed to the Chairman of the Tonbridge Gas Company, and endorsed "Tender for Gas Coal."

The Directors do not bind themselves to accept the lowest or any tender.

THOMAS WILTON,
Secretary.

Tonbridge, May 6, 1893.

CARDIFF GASLIGHT AND COKE COMPANY.

TENDERS FOR COALS.

THE Directors of the above Company are prepared to receive TENDERS for a supply of 50,000 tons of best, well-screened, large GAS COALS, to be delivered between July, 1893, and June 30, 1894, in monthly quantities, in accordance with the Specification.

Parties tendering may do so for the whole quantity or for quantities from 5000 tons upwards.

Forms of Tender and Specification of monthly deliveries may be obtained on application to Mr. H. Morley, the Company's Engineer.

Sealed tenders to be sent to the undersigned not later than Thursday, the 8th day of June next, addressed to the Chairman of the Company, and endorsed "Tender for Coal."

The Directors do not bind themselves to accept the lowest or any tender, and reserve to themselves the right to apportion the whole quantity as they may think fit.

By order,
GEORGE CLARRY,
Secretary.

Gas Offices, Cardiff,
May 10, 1893.

BOROUGH OF MANSFIELD.

THE Gas Committee invite Tenders for the supply of 5500 tons of best screened GAS COAL and NUTS, also 500 tons of CANNEL, for use at the Gas-Works, to be supplied for One Year ending May 31, 1893.

Particulars may be obtained from Mr. Hearson, Gas-Works, Mansfield.

Tenders to be sent in on or before the 31st of May, 1893, marked "Tender for Coal," and addressed to

R. J. PARSONS,
Town Clerk.

Mansfield, May 5, 1893.

TENDERS FOR GAS COAL.

THE Widnes Corporation invite Tenders for the supply of about 15,000 tons of GAS COAL (slack, "through and through," or screened Coal), to be delivered at the Gas-Works, Widnes.

Conditions and Forms of Tender may be obtained from Mr. Carr, Assoc.M.Inst.C.E., Gas Engineer, Widnes.

Tenders, to be addressed to the Chairman of the Gas Committee, endorsed "Gas Coal," and delivered to the undersigned not later than Eleven a.m. on the 6th of June prox.

The lowest or any tender will not necessarily be accepted.

H. S. OPPENHEIM,
Town Clerk.

Town Hall, Widnes,
May 12, 1893.

CAMBRIDGE UNIVERSITY AND TOWN GAS-LIGHT COMPANY.

TENDERS FOR COAL.

THE Directors of the above Company are prepared to receive TENDERS for the supply of 20,500 tons of CANNEL, best well-screened GAS COAL, and NUTS, to be delivered between the 1st of July, 1893, and the 30th of June, 1894.

Forms of Tender and Specification may be obtained on application to the undersigned.

Sealed tenders to be sent to the Chairman of the Company not later than the 12th day of June next, endorsed "Tender for Coal."

The Directors do not bind themselves to accept the lowest or any tender.

By order,
W. DUESBURY,
Manager.

Gas-Works, Cambridge,
May 5, 1893.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Leek Improvement Commissioners invite TENDERS for the supply of best screened GAS COAL and CANNEL for One, Two, or Three Years from the 1st of July next, to be delivered at the Leek Station, on the North Staffordshire Railway, at such times and in such quantities as may be required.

Annual consumption, about 4500 tons of Coal and 1000 tons of Cannel.

Further Particulars and Forms of Tender may be obtained from the undersigned.

Sealed and endorsed tenders, addressed to the Chairman of the Gas Committee, to be delivered at the Town Hall, Leek, by Four o'clock in the Afternoon of Monday, the 29th of May inst.

The lowest or any tender will not necessarily be accepted.

By order,
C. HENSHAW,
Clerk.

Town Hall, Leek,
May 12, 1893.

TO TAR DISTILLERS, MANUFACTURING CHEMISTS, AND OTHERS.

THE Directors of the Rochester, Chat-ham, and Strood Gaslight Company are prepared to receive TENDERS for the purchase of the surplus TAR and AMMONIACAL LIQUOR produced at their Works at Rochester and Gillingham for One Year commencing the 1st of July next.

In 1892 the quantity of Tar was about 306,000 gallons; of Liquor, about 960,000 gallons.

Further particulars may be had on application at the Office of the Company.

Tenders may be for Tar or Liquor separately or together, and are to be delivered at the Office, marked "Tender for Tar," or "Liquor," not later than Noon of Thursday, the 1st of June, 1893.

The Directors do not bind themselves to accept the highest or any tender; and security for due fulfilment of the contract must be given if required.

WILLIAM SYMS,
Secretary and Manager.

Gas Offices: 58, High Street, Rochester,
May 4, 1893.

LURGAN GAS LIGHT, AND CHEMICAL COMPANY, LIMITED.

COAL WANTED.

THE Directors invite Tenders for the supply of 2500 tons of best screened GAS COAL, delivered into Lighters *ex*-ship at Belfast, free of all charges.

Delivery of 2000 tons will be taken before the 1st of November next; the remainder to be delivered at such times before the 1st of April, 1894, as may be required.

Vessels carrying from 200 to 300 tons can at once deliver into Lighters; and these Lighters be back for a further cargo within a period to be arranged and agreed upon by the Gas Company.

Tenders (in sealed envelope), accompanied by reference to Gas-Works using the Coal offered, should reach me not later than Ten o'clock in the Forenoon of Monday, the 5th of June next.

The Directors do not bind themselves to accept the lowest or any tender.

FRED. W. MAGAHAN,
Secretary.

Gas-Works, Lurgan,
May 8, 1893.

TAUNTON GASLIGHT AND COKE COMPANY.

THE Directors are prepared to receive TENDERS for the supply of COAL over a Year from the 1st day of July next.

Particulars may be obtained from the Secretary, to whom sealed offers to supply (endorsed "Tender for Coals") should be sent not later than the 31st of May next.

By order,
A. EDWARDS,
Secretary and Manager.

May 12, 1893.

TO COLLIERY OWNERS.

THE Gas Committee of the Corporation of Blackpool are prepared to receive TENDERS for the supply of COAL and CANNEL for the next Twelve Months.

Forms of Tender may be had from the undersigned.

Tenders, endorsed outside, and addressed to the Chairman of the Gas Committee, to be sent in by the 27th day of May.

(Signed) JOHN CHEW,
Engineer.

Gas Office, Blackpool,
May 13, 1893.

RAMSBOTTOM GAS COMPANY.

TENDERS FOR COAL.

THE Directors of the above Company are prepared to receive TENDERS for the supply of 5000 tons of COAL, to be delivered during the period of Twelve Months ending June 30, 1894.

Sealed tenders, endorsed "Coals," and addressed to the Chairman of the Company, to be sent in not later than Saturday, the 27th of May.

The Directors do not bind themselves to accept the lowest or any tender.

Forms of Tender and further Particulars on application to

JOS. C. INGHAM,
Manager.

Gas-Works, Stubbins,
May 9, 1893.

TAR AND AMMONIACAL LIQUOR.

THE Directors of the Scarborough Gas Company invite TENDERS for the purchase of the AMMONIACAL LIQUOR and surplus TAR produced at their Works for a term of One Year from the 1st day of July, 1893.

Conditions of Tender and necessary Particulars will be supplied on application to the undersigned, to whom tenders, in accordance with such conditions, and properly endorsed, must be delivered not later than Saturday, the 3rd day of June next.

The Directors do not bind themselves to accept the highest or any tender.

By order,
WILLIAM J. MOON,
Secretary and Manager.

Gas Offices, Scarborough,
May 12, 1893.

LINCOLN CORPORATION.

(GAS DEPARTMENT.)

TENDERS FOR COAL.

THE Gas Committee of the Lincoln Cor-poration invite TENDERS for the supply of 20,000 tons of screened GAS COAL, COBBLES, and NUTS, to be delivered during a period commencing the 1st of July, 1893, and terminating the 30th of June, 1894.

Further Particulars and Forms of Tender may be obtained from the undersigned.

Sealed and endorsed tenders, addressed to the Chairman of the Gas Committee, must be delivered on or before the 29th inst.

The Committee do not bind themselves to accept the lowest or any tender.

JNO. CARTER,
Manager.

Gas Offices, Lincoln,
May 5, 1893.

BAHIA GAS COMPANY, LIMITED.

NOTICE is hereby given, that the ORDINARY HALF-YEARLY GENERAL MEETING of this Company will be held at the Company's Offices, 9, Queen Street Place, Cannon Street, London, E.C., on Thursday, the 18th day of May, 1893, to receive the Report of the Directors, the Balance-Sheet confirmed by the Auditors, and for General Purposes.

The Chair will be taken at Three o'clock precisely.

The Transfer Books are closed from the 4th to the 18th inst. inclusive.

By order of the Board,
THOMAS GUYATT,
Secretary.

May 6, 1893.

WEST HAM GAS COMPANY.

SALE OF 1750 SHARES.

MR. ALFRED RICHARDS is instructed by the Directors of the Company to SELL BY AUCTION, at the Mart, E.C., on Tuesday, May 30, at Two o'clock precisely, in Lots of 10 Shares each, 1750 £10 SHARES in the West Ham Gas Company.

The authorized Standard Dividend is 7 per cent., subject to the usual Sliding Scale Clauses.

The last Dividend on the same class of Shares was 5 per cent. per annum.

Particulars of the SECRETARY at the Company's Offices, STRATFORD, E.; of MESSRS. HILLEARY, Solicitors, 5, FENCHURCH BUILDINGS, E.C.; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

TOTTENHAM AND EDMONTON GASLIGHT AND COKE COMPANY.

SALE BY TENDER OF £15,000 NEW STOCK, 1882.

IN pursuance of the Tottenham and Edmonton Gas Act, 1882, Notice is hereby given that it is the intention of the Directors to SELL BY TENDER £15,000 of NEW STOCK of the Company, to be paid up in full on or before the 31st of July next, after which date Dividend will commence to accrue, such Stock being the second portion of additional Capital authorized to be raised by Resolutions passed at an Extraordinary Meeting of the Proprietors, held on the 22nd of February, 1890, under the powers of the above-mentioned Act.

The Dividend on the Stock will be calculated half yearly up to the 31st of December and the 30th of June in each year, and will be paid by warrant issued within one week following the Half-Yearly Meeting of the Company, usually held on the last Saturday in February and August respectively in each Year.

A Deposit of 10 per cent. of the nominal amount of the Stock tendered for must accompany each tender.

Any amount not being less than £5, or a multiple thereof, may be tendered for; and the Stock will be registered in the Company's Books in the names of Allottees or their Nominees free of expense.

The minimum price below which no tender will be accepted has been fixed at One Hundred and Fifty Pounds Sterling (£150) for each One Hundred Pounds (£100) of Stock.

Particulars and Conditions of tender may be obtained on application to this Office; and sealed tenders must be sent in not later than Four o'clock in the Afternoon on Friday, the 16th day of June next.

By order of the Board,
JAMES RANDALL,
Secretary.

Offices of the Company:
Willoughby Lane, Tottenham,
May 5, 1893.

NOTICE OF REMOVAL.

TO GAS ENGINEERS & MANAGERS.

CROWTHER BROS.,

Contractors for Retort Setting, Erection of Gas Apparatus, and General Repairs, **have removed from 384, Mile End Road, to**

152, TEVIOT ST., ST. LEONARD'S ROAD, POPLAR, LONDON, E.

JAMES WHITE & CO., LTD.,

WIDNES, LANCASHIRE,

Manufacturers of Special

FIRE-BRICKS, FIRE-CLAY, & FURNACE CEMENT.

FOR GAS FURNACES our GANNISTER and SILICA FIRE-BRICKS are acknowledged to be the best and most durable in the Market.

GANNISTER and SILICA FIRE-CLAY guaranteed of the Purest Quality.

FURNACE CEMENT specially made for repairing Furnaces and stopping Cracks.

ANALYSIS AND REFERENCES ON APPLICATION.

HOLMSIDE GAS COALS.
(Wrought out of Holmside and South Moor Collieries.)

PRESENT production over 3200 tons per working day. Area of coal about 5000 acres, including the largest remaining workable proportion of pure HUTTON SEAM GAS COAL. Analysis of HOLMSIDE GAS COAL *in bulk as shipped* gives 10,500 cubic feet of Gas per ton, of an Illuminating Power of 16¼ candles. The Sulphur is about 1 per cent., and the Ash 1¾ per cent. The Coal cokes well, and leaves about 70 per cent. of excellent Coke. To show the progress of HOLMSIDE COALS, it may be mentioned that the quantity carbonized by the London Gas Companies in 1885 was about 200,000 tons; whereas the present consumption of HOLMSIDE COALS in London alone is at the rate of over

400,000 Tons per Annum.

Full particulars on application to

MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-ON-TYNE.

BOLDON GAS COALS.

Worked by THE HARTON COAL CO., LTD.,

Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton . .	10,500	Cubic Feet.
Illuminating Power . .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to

The Gaslight and Coke Company, South Metropolitan Gas Company, Commercial Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Ipswich Gaslight Company, Devonport Gas Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For prices, &c., apply to the

HARTON COAL COMPANY,
LIMITED,
Newcastle-on-Tyne.
W. H. PARKINSON,
FITTER.

HUNTER'S

OXIDE OF IRON.

JAMES HUNTER, LESSEE, MINER, AND SHIPPER OF NATURAL IRISH BOG ORE.

This Estate yields the finest and most uniform quality in Ireland; and the quality is guaranteed.

Samples and Prices on application.

11, BAY STREET, PORT GLASGOW.

Telegrams: "HUNTER PORT GLASGOW."

Established 1872.

THORNLEY GAS COALS

WORKED BY THE

WEARDALE IRON AND COAL COMPANY, Ld.

OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

The Analysis made by Messrs. J. and H. T. PATTINSON, Public Analyst for Northumberland, gives 10,500 cubic feet of Gas per ton, with an Illuminating Power of 16·3 Candles and 67·3 per cent. of Coke. The following is a working Analysis made of these Coals by the Falmouth Gas Company:—

[COPY.]
FALMOUTH GAS COMPANY,
Offices: *Church Street, Falmouth,*
January 25th, 1893.

Messrs. the

WEARDALE IRON & COAL COMPANY, LTD.,
NEWCASTLE-ON-TYNE.

GENTLEMEN,

From the Cargo of **THORNLEY GAS COAL,** received early this month from you, I have Carbonized at these Works, during a period of thirteen consecutive days, 151$\frac{15}{20}$ tons of the Coal, mixed with 9$\frac{6}{20}$ tons of Cannel Shale (or about 6 per cent.)

The Make of Gas during the above period was 1,624,000 cubic feet.

The whole of the Gas was made from four beds of sixes (24 mouthpieces); each charge being of six hours' duration.

Gas made: 1,624,000 cubic feet.
Coal Carbonized: 151$\frac{15}{20}$ tons.
Cannel Shale: 9$\frac{6}{20}$ tons.
Make per ton of Coal and Cannel Carbonized: 10,082 cubic feet.
Coke per ton (of good quality): 13¼ cwt.

The ILLUMINATING POWER averages from 11 daily tests, **16·54 CANDLES,** which was ascertained by burning the Gas at the rate of 5 cubic feet per hour in a certified Letheby Photometer, fitted with a Standard Argand, each Candle consuming 120 grains of Sperm per hour.

Yours faithfully,
J. WM. BUCKLEY,
Engineer and Manager.

For Price, &c., apply to the

WEARDALE IRON & COAL Co., Ld.,
QUAYSIDE, NEWCASTLE-ON-TYNE.

G. WALLER & CO.'S NEW PATENT GAS EXHAUSTER

MADE WITH FOUR BLADES,

To pass 300,000 Cubic Feet per Hour, with or without Engine combined.

IN USE AND ON ORDER FOR OVER 100 WORKS,

AND EQUAL TO

5,340,000 CUBIC FEET PER HOUR.

SPECIAL ADVANTAGES:—

The Four-Blade Exhauster **PASSES 50 PER CENT. MORE PER REVOLUTION** than any One or Two Blade Exhauster.
It takes 27 per cent. less power than any Two-Blade Exhauster.
It gives a steadier Gauge than any other Exhauster.
One of our 150,000 feet per hour Patent Four-Blade Exhausters passes continuously **180,000** cubic feet per hour, driven by a **12-INCH STEAM CYLINDER.** No other Maker can give a similar result.
Model of Patent Exhauster sent for inspection.
Oldest Makers of Beale Exhausters for over 300 Works.
Patent Compensating Steam Governor, Special Tar and Liquor Pumps, Gas-Valves.
Washer-Scrubbers, with **WOOD CLUSTERS,** and Tar Extractor combined.

PHŒNIX ENGINEERING WORKS,
PARK STREET, SOUTHWARK, LONDON, S.E.

LONDONDERRY GAS COALS

FROM THE

MARQUIS OF LONDONDERRY'S COLLIERIES,

COUNTY OF DURHAM.

Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by Mr. John Pattinson, F.C.S., F.I.S.

FOR PRICES AND PARTICULARS, APPLY TO

S. J. DITCHFIELD,
SEAHAM HARBOUR, COUNTY OF DURHAM.

THE SILICA FIRE-BRICK COMPANY,

OUGHTIBRIDGE, near SHEFFIELD,

MANUFACTURE

SILICA BLOCKS, BRICKS, AND CEMENT

OF SUPERIOR QUALITY

FOR GAS-FURNACES.

Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their

GREATER DURABILITY

Strongly recommended where EXCESSIVE HEATS have to be maintained.

NIDDRIE CANNEL

A FIRST-CLASS CANNEL COAL,

Yielding a large volume of rich Gas, and fully 60 per cent. of first-class Coke.

FOR ANALYSIS, PRICE, AND ALL OTHER PARTICULARS, APPLY TO

The Niddrie & Benhar Coal Co., Ltd.,
4, York Buildings, Queen Street, EDINBURGH.
Telegrams: "BENHAR, Edinburgh."

MEIKLEJOHN'S PATENT

Improved Slide-Valve Anti-Dip.

Is perfectly reliable in action, and requires no attention. Has all the advantages of the Dip and Anti-Dip combined.
Is cheap and easily fixed to any form of main.
Will be found the most efficient appliance of the kind yet introduced.
Further particulars and price from

C. MEIKLEJOHN,
GAS-WORKS, RUGBY.
(Late N. MEIKLEJOHN, Longwood.)

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY,

LIMITED,

NEWBATTLE COLLIERIES,

DALKEITH, N.B.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for

CANNEL & COAL.

TYNE

BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	73·1 per cent.

For Prices and complete Analysis, apply to

THOS. W. DANCE & SONS,
COAL OWNERS, NEWCASTLE-ON-TYNE.
OR
E. FOSTER & CO.,
21, JOHN STREET, ADELPHI, LONDON, W.C.

"YEADON"
REVOLVING GAS-RETORTS
(YEADON AND ADGIE'S PATENTS)
POSSESS THE FOLLOWING ADVANTAGES OVER ALL OTHERS:—

1. Occupy only one-fourth the space of ordinary Carbonizing Plant.
2. Continuous Automatic process; Gas produced in 12½ minutes.
3. Produce 25 per cent. more Gas per Ton of Coal carbonized.
4. Richer Gas of 15 per cent. additional Illuminating Power.
5. Utilize the smallest size, therefore the lowest price, Coal.
6. Proportionate increase from large Coal when broken as for Stoking-Machines.
7. Enrichment of Gas, by Oils, &c., rendered unnecessary.
8. No deposit of Carbon in Retorts, or choked Ascension-Pipes.
9. Fogs conquered by the production of Gaslight on five hours' notice.
10. 25 per cent. of Lime saved in the process of Purification.
11. Retorts can be used for Revivifying Spent Lime in 20 minutes.
12. Revivify Spent Oxide for the recovery of Sulphur Compounds.
13. Sunday Ordinary Labour and Nightwork reduced 75 per cent.
14. Overwork and Overtime abolished; also Casual and Foreign Labour.

For Articles on and descriptive of the above Apparatus, see *Journal of Gas Lighting* for Dec. 13, 1892; March 7, April 25, and May 2, 1893. Also, the *Gas World*, Jan. 21 and May 6, 1893.

FULL PARTICULARS AND ESTIMATES GIVEN BY

THE YEADON GAS-RETORT SYNDICATE, LIMITED,
4, ALBION PLACE, LEEDS;

OR THEIR SOLE REPRESENTATIVES: **D. M. NELSON & SONS, 68, Bath Street, GLASGOW.**

TROTTER, HAINES, & CORBETT,
Brettell's Estate
FIRE-CLAY & BRICK WORKS,
STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY.
SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

CAST-IRON PIPES
FOR GAS AND WATER.
Pipes, One to Six inch Bore, kept in Stock. Also a very large assortment of all sizes of Bends, T-pieces, and Specials ready for despatch on receipt of Order.

VALVES
FOR GAS, WATER, AND STEAM.

TELEGRAMS: "PIPES GLASGOW."
WM. MACLEOD & CO.,
56, ROBERTSON STREET, GLASGOW.

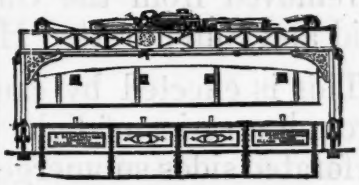
AUG. KLÖNNE,
DORTMUND (GERMANY).
REGENERATIVE FURNACES.
Unsurpassed in
Efficiency, Economy, Durability, and Easy Working.

T. B. KITTEL, SHEFFIELD.
CONTRACTS FOR SUPPLIES OF ANY OF THE PRINCIPAL
ENGLISH & SCOTCH CANNELS.
REAL SILKSTONE GAS COAL
ANALYSIS AND PRICES ON APPLICATION.
T. B. KITTEL, SHEFFIELD.

PRICE'S PATENT COKE & COAL BARROW

effecting a great saving of time labour, and expense.
For particulars, price, &c., apply to Mr. E. PRICE, Inventor and Patentee, 23, Alwyne Road, Canonbury, LONDON, N.
Prices are Reduced.

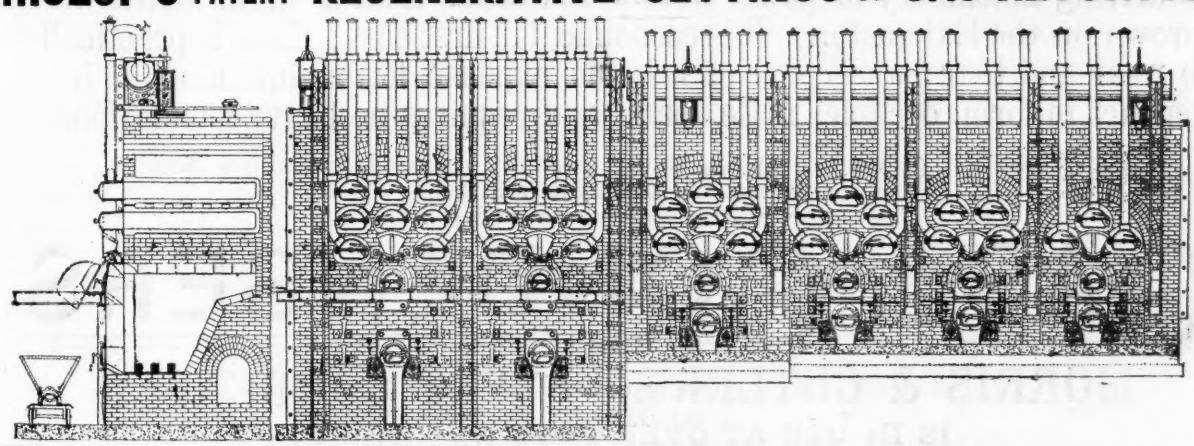
DEMPSTERS'



PURIFIERS (MACHINED JOINTS)
PURIFIERS.
ELLAND.

BEST
GAS COAL. **REAL OLD SILKSTONE GAS COAL,**
Address THE STRAFFORD COLLIERIES COMPANY,
Near **BARNSLEY, SOUTH YORKSHIRE.**

HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE ADAPTED TO THE REQUIREMENTS OF ALL GAS COMPANIES AND GAS CORPORATIONS, AND HAVE ALREADY BEEN EXTENSIVELY ADOPTED. THEY ARE ERECTED UPON BOTH THE WORKING-STAGE AND SHALLOW-CHAMBER SYSTEMS, AND EQUALLY SATISFACTORY RESULTS ARE GUARANTEED IN BOTH CASES.

THE SETTINGS HAVE ATTAINED TO A MEASURE OF SUCCESS AND POPULARITY QUITE UNEQUALLED BY THAT OF ANY OTHER WITHIN THE SAME SPACE OF TIME. THE WORKING RESULTS OBTAINED, AND THE GENERAL SATISFACTION GIVEN, ARE DECLARED IN EVERY CASE TO EXCEED, AND IN MOST CASES CONSIDERABLY EXCEED, THE PATENTEE'S GUARANTEE. THE CONSTRUCTION AND WORKING OF THE PATENT PRODUCER AND THE PATENT CHARGING APPARATUS FOR SAME ARE ABSOLUTELY UNIQUE AND UNRIVALLED, AND ARE THE DELIGHT OF EVERY STOKER; WHILE IN EVERY OTHER PARTICULAR THEY SECURE THE HIGHEST RESULTS ATTAINABLE BY ANY REGENERATIVE SYSTEM, AND AT A MINIMUM OF COST.

Drawings and Specifications are furnished for the complete erection of Ovens, with or without Retort and Bench Mountings, or complete erection undertaken if required, and carried out by specially Trained Workmen.

Further particulars may be obtained on application to the Patentee's Agents: C. M. HAMILTON, 5, Stewart Street, Shawlands, Glasgow; J. E. FISHER, Stourbridge, and from R. F. HISLOP (son of Patentee), Gas-Works, Paisley.

HISLOP'S PATENT HYDRAULIC MAIN SEAL-REGULATING AND TAR-EXTRACTING VALVE is a *Sine quâ non*
TO THE SATISFACTORY WORKING OF THE HYDRAULIC MAIN UNDER THE REGENERATIVE AS WELL AS OTHER SYSTEMS OF RETORTS. BEING LARGELY ADOPTED, AND AFFORDING THE HIGHEST SATISFACTION.

SPENT LIMES NO LONGER WASTE PRODUCTS
Under G. R. HISLOP'S PATENTS.
All Spent Limes are most effectually, economically, and continuously recovered at from one-third to one-half the cost of New Lime. The results are surprise to all who have inspected the process, and are entirely satisfactory to all now using it.
Descriptive Pamphlets and Terms from Agents as above.

THE CHARLES HUNT GAS WASHER

(HUNT'S PATENT).

By this Washer, which performs the functions of both a Washer and Scrubber, any tarry matters are intercepted, and the whole of the Ammonia is removed from the Gas, together with a high percentage of Carbonic Acid and Sulphuretted Hydrogen.

This is effected by causing the Gas to pass in finely-divided streams through a series of light seals, formed by inverted troughs, having their perforated sides submerged in liquid, and placed one above another. Clean Water, being introduced at the top and flowing from tier to tier in the opposite direction to the Gas, leaves the Washer at the bottom as strong Ammoniacal Liquor.

The lower tiers perform the function of a most efficient Tar Extractor, removing from the Gas all traces of tarry matters.

The total back pressure due to this apparatus does not exceed about 7 ins.

The advantages claimed for the Washer are: **It is entirely automatic in action**, depending only upon a constant supply of clean water, proportionate in quantity to the volume of Gas passing. **It has no moving parts**, and thus **no driving machinery or power** is required other than a slight extra duty thrown on the Exhauster. **It is economical in first cost**; there is **practically no wear and tear**; and consequently **no expense for maintenance.** It is **compact in form, occupies little space, and requires no heavy foundations.**

For prices and particulars apply, stating capacity required, to the Sole Makers, Messrs. S. CUTLER & SONS.

GAS CONDENSERS

MORRIS & CUTLER'S PATENT CONDENSER

IS IN USE AT OVER 80 GAS-WORKS.

It is Independent of Atmospheric Temperature,
Prevents the Formation of Naphthaline,
Is Readily Adjusted to Condense varying makes of Gas,
Acts as a Frictional Tar-Separator,
Efficient, Compact, Convenient, Ornamental.

Sole Makers, Messrs. S. CUTLER & SONS.

GASHOLDERS of EVERY SIZE and TYPE.

SAML. CUTLER & SONS, MILLWALL, LONDON.

Westminster Office: 16, GT. GEORGE STREET.

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on application

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD
BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

JAMES OAKES & Co.,
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road,
CITY ROAD, LONDON, N.

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, 1¼ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas Water, Railway, Telegraph Chemical, Colliery, and other Companies.

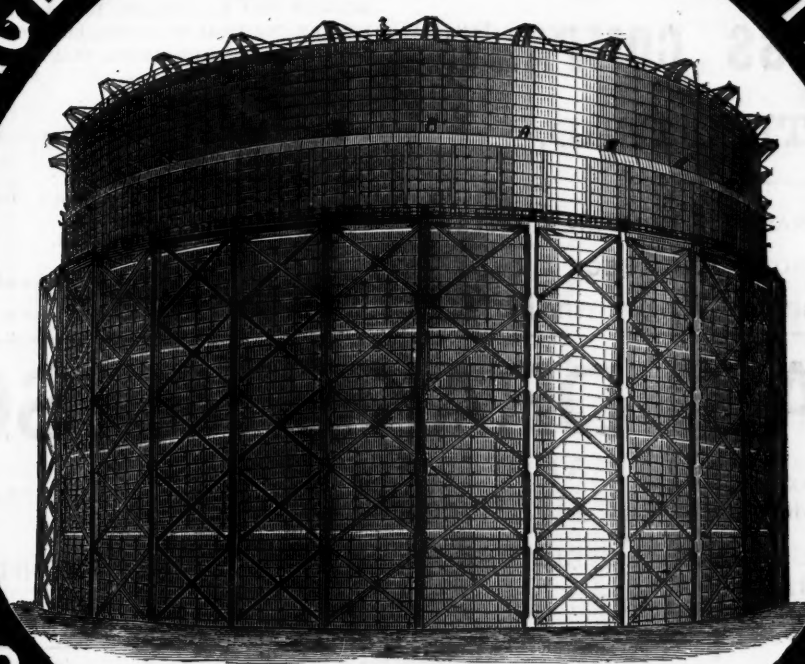
NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts, and covers, and rendering leakage impossible.

THOMAS TURTON
AND SONS, LIMITED,
SHEAF WORKS, SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.
London Office:
90, CANNON STREET, E.C.

CLAYTON SON & Co. LTD
MAKERS OF
WORKS LEEDS

THE LARGEST GASHOLDER IN THE WORLD

GASHOLDERS OUR SPECIALITY



CAPACITY 12 MILLION CUBIC FT.

ERECTED AT EAST GREENWICH FOR THE
South Metropolitan Gas Company
IT HAS SIX LIFTS 30 FT
DEEP EACH AND IS
300 FT DIAR

MAKERS OF GAS PLANT OF EVERY DESCRIPTION

ROOFS PURIFIERS &c. ALSO GASHOLDERS OF ANY SIZE

ERECTED & COMPLETED WITHIN 12 MONTHS AND AT THE TIME SPECIFIED

ADDRESS
LONDON
60, QUEEN
VICTORIA ST.
TELEGRAPHIC
"GAS, LEEDS."

ALEX. C. HUMPHREYS, M.E.,
General Superintendent & Chief Engineer,
The United Gas Improvement Company, U.S.A.

A. G. GLASGOW, M.E.,
Late General Inspector,
The United Gas Improvement Company, U.S.A.

HUMPHREYS & GLASGOW,

Contracting Engineers for Water Gas Plant,
9, Victoria Street, London, S.W.

WILLIAM INGHAM & SONS,

Incorporated with the Leeds Fire-Clay Company, Ltd.,
WORTLEY FIRE-CLAY WORKS
Near LEEDS,

Have confidence in drawing the special attention of GAS ENGINEERS to the following advantages of their Retorts:—

1. Smooth interior, preventing adhesion of Carbon.
2. They can be made in one piece up to 10 feet long.
3. Uniformity in thickness, ensuring equal Expansion and Contraction.

PATENT
MACHINE-MADE GAS-RETORTS.

GAS AND WATER PIPES
AND
CASTINGS OF EVERY DESCRIPTION.

MANUFACTURED BY THE

CLAY CROSS COMPANY,
CHESTERFIELD.

TRADE	TELEGRAMS:	LONDON AGENTS:
C X C	"JACKSON"	BECK & Co.,
MARK.	CLAY CROSS.	130, GT. SUFFOLK ST., S.E.

GODDARD, MASSEY, & WARNER'S
IMPROVED
Sulphate of Ammonia Apparatus.

The most successful and approved Apparatus known up to the present time.

FOR REFERENCES, PARTICULARS, TESTIMONIALS, AND PRICE APPLY TO

GODDARD, MASSEY, & WARNER,
ENGINEERS,
NOTTINGHAM.

The Apparatus has been supplied to the following Firms—

BURT BOULTON, & HAYWOOD, SILVERTOWN, and ELING.
CHANCE BROTHERS, OLDBURY (Four Apparatus).
RUNCORN SOAP & ALKALI CO., Limited, RUNCORN.
NETHAM CHEMICAL CO., Limited, BRISTOL.
ANIMAL CHARCOAL CO., Limited, SHADWELL.
WM. BUTLER & CO., BRISTOL.
KEMPSON & CO., Pye Bridge.

And to the following Gas Companies and Corporations—

ILKESTON.
WIDNES.
HALIFAX.
ALTRINCHAM.
DENTON.
ST. ALBANS.
DUKINFIELD.
NORTHWICH.
HUDDERSFIELD.
BURY.
BRIGHOUSE.
MARKET HARBRO'.
PRESCOT.
SOWERBY BRIDGE.
LEICESTER.
DARWEN.
NELSON.
ORMSKIRK.
CHORLEY.
WHITEHAVEN.
CHESTER.
SOUTH SHIELDS.
LEEK.
IPSWICH.
BOURNEMOUTH.
SALFORD.
LUTON.
HAMPTON COURT.

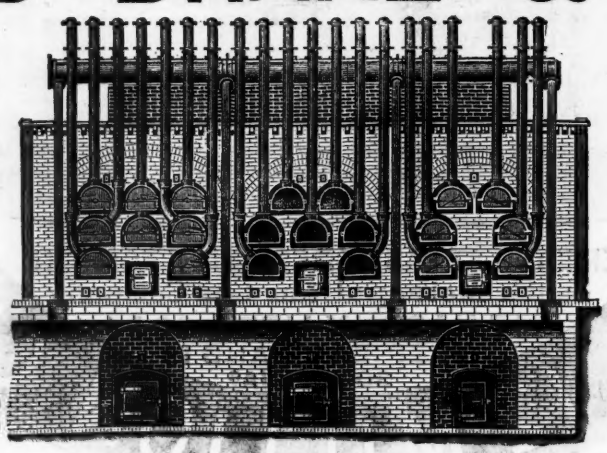
JONAS DRAKE & SON,

TELEGRAPHIC ADDRESSES:
"DRAKESON, HALIFAX."
"ECLAIRAGE, LONDON"

TELEPHONE No. 43.
HALIFAX EXCHANGE.

GAS ENGINEERS,
CONTRACTORS,
IRONFOUNDERS,

BUILDERS AND ERECTORS OF EVERY DESCRIPTION OF OVENS, BENCHES, KILNS, FURNACES, &c.



RETORT SETTERS,
FURNACE BUILDERS
ETC., ETC.

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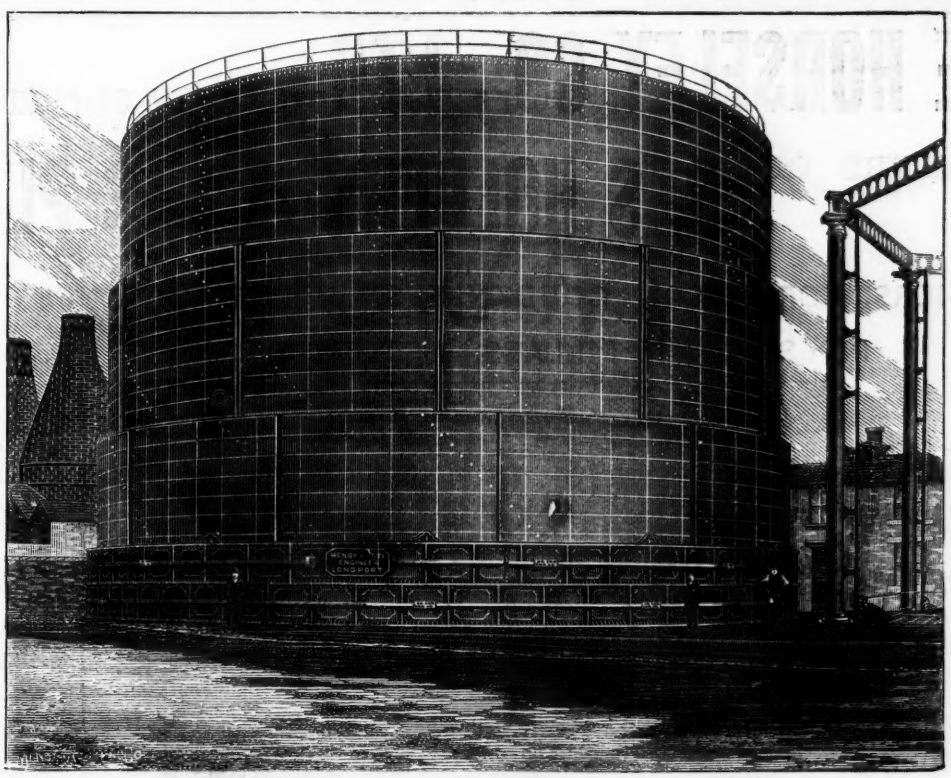

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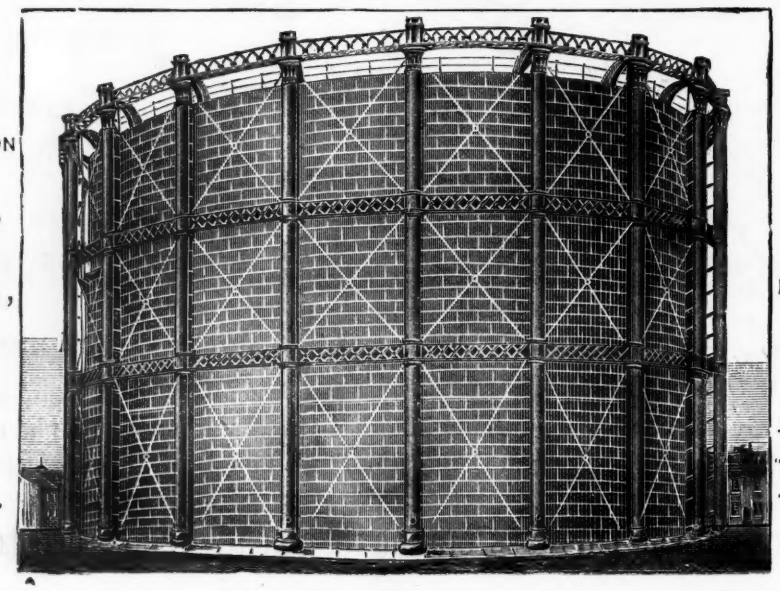

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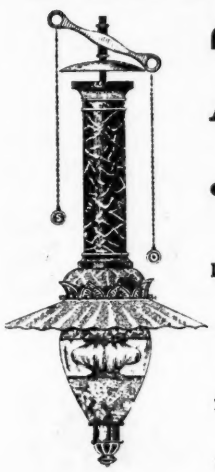

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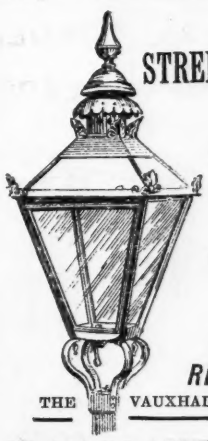

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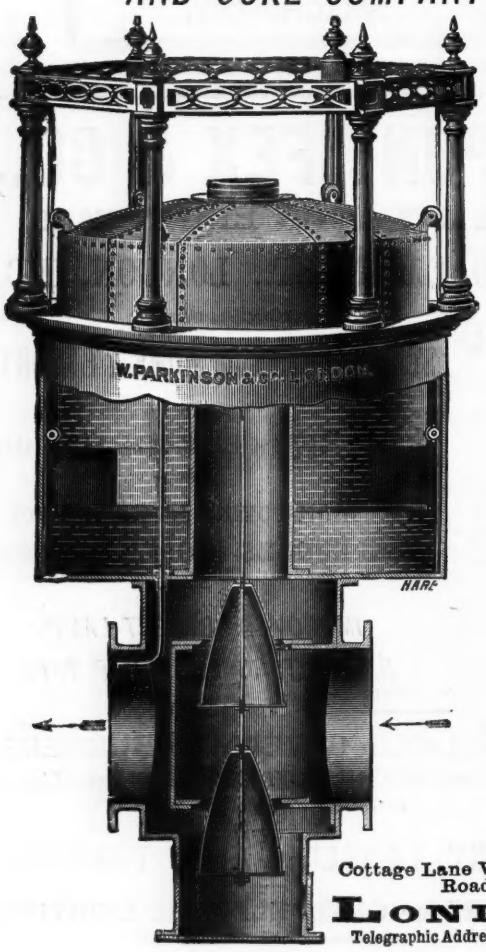

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[See also Advt., p. 860.

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